

OUT-OF-ORDER

The functioning artwork in relation to electronic art and experimental art-devices

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Abstract

This thesis questions the role of electronics in art. It defines the meaning and consequences of non-functioning or out-of-order art when electrical components are used. Furthermore it presents a practical exploration and a case-study of an exhibition in order to answer the following research question: ‘What is a functioning artwork in relation to electronic art and experimental art-devices?’

Before one can identify an out-of-order artwork, the electronic art-field has to be defined. Electronic art can be described as a form of new media art, which uses electronics as a medium to explore systems, functions and technological possibilities. Electronic art-pieces can break in a technological sense, due to their use of electrical components. A non-functioning electrical artwork poses a problem, as it loses a major part of its meaning. When an out-of-order artwork needs to be repaired, the different styles that artists employ for creating electronic art-pieces need to be taken into account. Different strategies for dealing with irreparable artworks are discussed in this thesis. In order to prolong the lifespan of an electrical artwork, artists and institutions should both take responsibility for documenting art-pieces. Where institutions are becoming more aware of their role in the documentation process, artists could take more initiative in providing additional material.

Art-devices were developed as a practical exploration of the role of electronics in art and out of curiosity towards how appliances, systems, and electrical objects function. They can be described as objects that produce light, sound or movement and can be composed with, controlled or influenced by a user. The electronic component is the medium of the art-device and thus produces its meaning. The art-device is closely related to a musical instrument, but where an instrument creates pre-determined tones when played, the output that an art-device produces does not have to follow a logical structure. The art-devices and their respective hand-drawn schematics, user-manuals and a volume with background information were exhibited in the Tekniikan Museo in Helsinki in February 2017. From this exhibition the following could be concluded: Curiosity needs privacy, audience treats art-devices more carefully than expected and out-of-order instances occur due to bad design, insufficient testing and empty batteries.

Keywords *electronics, functioning, out-of-order, art-device, instrument*

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Special thanks to the staff from the Tekniikan Museo and especially Johanna Vähäpesola and Tapani Mikkola for hosting my 'Out-of-Order' exhibition; Saara Kanerva Tamminen for providing translations to Finnish for the exhibition book; Riikka Toivonen for transportation of the art-pieces.

Helsinki, May 2017

what it might do
what it can do
what the audience does with it
what it makes the audience think

(from my notes, Marloes van Son, 2017)

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Introduction

My fascination with non-functioning art-pieces began in late autumn of 2013 during a visit to the Museu Coleção Berardo in Lisbon. One of the art-pieces exhibited was 'I set fire to my name' (1969) by Jannis Kounellis. Which consists of a metal tube structure with a gas-flask attached. I expected something to happen, but when I visited the exhibition this contraption did nothing. Or maybe it did work, but was too dangerous to be functioning without permanent supervision. The solution that the museum came up with, was to attach a note to the art-piece that read: 'out-of-order', while keeping the work in a non-functional, non-recognisable state within the exhibition. I later found out that it should have displayed the artist's name in flames.

In October 2015 I visited the Venice Biennale. The lack of electronic, reactive, sound or kinetic pieces surprised me. However, near the entrance of the Arsenale exhibition I thought I had found some kinetic sound pieces by Terry Adkins and Qiu Zhijie. First I watched them for a while, there were power cables attached and the installations were plugged in, but they did not seem to be switched 'on' permanently. I assumed they were working with some sort of timer switch. After a couple of minutes I asked a guard if these pieces were functioning, she told me that they were not. Even though I never saw these artworks in action, I still consider these as some of the most interesting works that I encountered at the Venice Biennale. I suspect that is exactly because they were not functioning. Due to these artworks being out-of-order, I was able to imagine how they might have worked, which lead me to automatically tune their workings to my own taste: even though they might actually work in a completely different way.

These encounters with out-of-order art-pieces form the starting point for my interest in non-functioning electrical art. I have been working with electronics in my own artworks for several years now, and know the struggle of testing, wear and tear and non-functionality all too well. At some point I started considering this as an inevitable aspect of working with electronics: the fact that I used electronics changed the durability and lifespan of my artworks. Since conveying my ideas towards an audience heavily relies on functioning electronics, I noticed that my artworks lose their meaning when they do not function. They seem to become relics of a possible functionality and no longer existing as an art-piece.

I started building art-devices as an exploration of different ways in which electronics can be used in art. This project transformed into a full series of experimental sound-devices and instruments that I started using for performances. With these devices I also explore curiosity and how an audience interacts with unknown interfaces.

This text only presents a temporary frozen moment in the Devices-project, as more ideas for devices keep on emerging and every presentation, performance or exhibition leads to additional questions.

Research question

This thesis questions the role of electronics in art. It tries to define the meaning and consequences of non-functioning or out-of-order art when electrical components are used. Furthermore it presents a practical exploration and a case-study of an exhibition in order to answer the following research question:

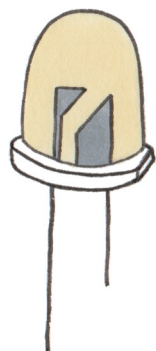
What is a functioning artwork in relation to electronic art and experimental art-devices?

Structure of the thesis

The first three chapters of this thesis introduce a more theoretical view on non-functioning electrical art. The following three chapters discuss my own practice as related to and inspired by this research. In the first chapter the electronic art-field will be identified among similar artistic practices. It will then describe sub-forms of electrical art and different approaches that artists have towards using electronics. The second chapter introduces out-of-order art and elaborates on the meaning of a functioning artwork when it incorporates electronics. It then continues to define possible reasons for non-functionality and strategies for dealing with this. The lifespan of electronic art is discussed in the third chapter. Furthermore the influence of conservation, preservation and documentation initiatives is addressed. The fourth chapter introduces art-devices in relation to experimental instrument building and composing for non-traditional instruments. My Devices-project is the topic of the fifth chapter, which elaborates on the different components and underlying ideas that the art-devices include. The sixth chapter presents my exhibition at the Tekniikan Museo in Helsinki as a case study, while discussing considerations on curiosity of the audience and behaviour of visitors. The concluding chapter will summarise the findings and ideas that emerged from this research.

In the first appendix visual documentation of my Devices-project can be found. The second appendix presents visual scores that can be used to perform with the devices in appendix one. The third appendix consists of notes that were made during the Out-of-Order exhibition in the Tekniikan Museo.

With this thesis a USB-drive is included that holds additional sound-recordings and animations which complete the Devices-project.



1. Art and electronics

This chapter will describe several relationships between art and electronics, different approaches that artists have towards using electronics and my own interpretations of those approaches.

Why art and electronics?

From an early age I have been interested in how things worked. I was always curious towards the inside of objects, whether those objects were old wooden boxes in secondhand stores, or the desktop computer that my dad was assembling on the carpet in the living-room. When I was about 14 years old, I built my first electrical circuit. For a group project at school we had to design and build a prototype for a motorcycle. My group chose to build an electrical version. As my dad had most of the components lying around at home, I was responsible for the circuitry. I soldered a battery-holder, small dc-motor and a switch together, built it into a wooden frame, and we had a functioning prototype. When I was about 17 years old and in my final year of secondary school, I built my first microcontroller-based art-project with some help. Since that project, almost every art-piece that I have made included some (reference to) electronics or electrical devices. Somehow art and electronics became inseparable to me.

Can an electronic art-field be defined?

As the reasons for using electronics within art greatly vary, an electronic art-field as such is not easy to define. This is partly due to the many different approaches for using electronics which I will describe in the following paragraph. Art using electronics is commonly grouped under new media art or kinetic art. Both of these art-classifications have a multitude of descriptions attempting to define them. These descriptions do not always agree with each-other. In 'New Media in the White Cube and Beyond' - a book describing curatorial models for Digital Art - the impossibility of defining new media art is even seen as a driving force of the field:

'The successful evasion of definitions is one of new media art's greatest assets and a main reason why so many artists, curators, and practitioners in general are attracted to this art form.' [1.1 - Paul, 2008, p3]

What many of the descriptions of kinetic and new media art do agree on is that these art-forms have shifted the focus of art from the object to a process-oriented approach:

'Like other art forms before it, new media art has shifted the focus from object to process: as an inherently time-based, dynamic, interactive, collaborative, customizable, and variable art form, new media art resists "objectification" and challenges traditional notions of the art object.' [1.2 - Paul, 2008, p1]

These processes can include explorations of new (technological) possibilities, which often means that the technology used becomes an integral part of and art-piece or experience. [1.3 - Wilson, 2002, p6] This often means that the art-piece loses its meaning, or might not even exist without its technological component.

Curator of new media arts Christiane Paul raises the point that one can distinguish two types of new media art; technologies as a tool, or as a medium. Artists using technology as a tool, either produce more traditional art-forms with the aid of technology (such as a sculptures or prints), or use technology to store or deliver works (in the form of a

digitized version of a painting on the Internet or a video on DVD). [1.4 - Paul, 2008, p3]

This same division between technology as a tool or as a medium can be made for audiovisual playback equipment. Ex-chief conservator of the Carnegie Museum of Art in Pittsburgh, William A. Real writes that:

'The role of the audiovisual playback equipment itself varies from installation to installation. In one installation, the playback equipment might primarily be a means to present the imagery and sound (video, film, slides, etc.), either hidden from view or otherwise not considered by the artist to be a meaningful visual component of the piece; only the proper presentation of the audiovisual material itself is important, regardless of the equipment used. By contrast, the equipment in another piece might also play a sculptural or conceptual role that is critical to the understanding of the piece.' [1.5 - Real, 2001]

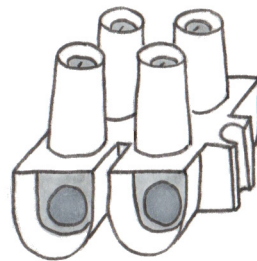
The staff of the Smithsonian Art Museum also realises that the role of electronic media varies within different artworks:

'(...) for some works, the look and feel of the original medium may be artistically relevant. For others, the main artistic consideration might be the "story" that the images tell. Knowing which is which can inform the preservation efforts appropriate to different works.' [1.6 - Smithsonian institution, 2010, p10]

A simplified way of defining the electronic art-field is to compare it to descriptions of kinetic art.

'Kinetic art is art that moves, motivated by human touch, natural forces such as wind, or by motor.' [1.7 - Wilson, 2002, p388]

Where kinetic art depends on motion for its effect, electronic art similarly depends on electronics. The electronics do not have to be interactive, connected to real-time data or the web, as is often a defining characteristic for new media art. In short one could define electronic art as a slightly old-fashioned sub-form of new media art, which uses electronics as a medium to explore systems, functions and technological possibilities.



A terminal block

In what ways are artists using electronics?

'An incidental use of technology in art refers to artistic work that uses a technology, but does not necessarily need that specific technology for the piece to exist, neither does it criticise or particularly engage with that technology. This mainly occurs when technology is treated the same way as traditional media, by for example treating it as a fancy paintbrush or camera.' [1.8 - Wilson, 2002, p6]

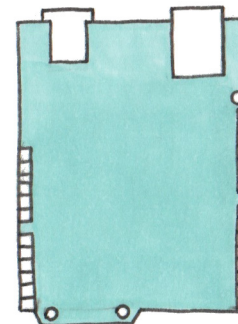
Following this statement that Stephen Wilson (Professor of Conceptual and Information Arts at San Francisco State University) made in 'Information Arts: Intersections of Art, Science, and Technology', one can describe several different approaches that artists have towards using electronics. I distinguish the following groups:

The end-user: only cares about the result, does not build his / her own systems, is not interested and thus not capable of assembling their own systems.

The appropriator: uses pre-made high-end electronics, does not solder or know how individual components work, but is capable of hooking up different (consumer-) electrical devices in order to create a functional end-user system - might use terminal blocks or attach their own power plug. Main electronics used are timer switches and movement sensors from hardware stores; plug and play equipment.

The hybrid: followed some workshops on electronics and managed to build a couple of functional systems within those. The hybrid will mainly keep on re-using these same systems that he / she learned to build, but he / she will not start an unknown chapter in electronics on their own initiative - knows how to solder, uses mainly kits and Arduino-shields [1.9 - arduino.cc] that do not require additional components. If the hybrid wants to make something electronic that they're not familiar with, they will ask for help. Uses breadboards sometimes, but does not know how to read schematics (yet).

The inventor: (this is where I group myself) Is a curious explorer of electronics. Knows how the main basic components work; what resistors, capacitors, diodes and some basic integrated circuits (IC's) do. Resulting from this basic knowledge the inventor can read (basic) schematics. The inventor sometimes uses Arduino-shields (mainly when they're around and a fast fix is desirable), but prefers to build their own from prototyping board or an etched circuit-board. Is aware of the risks that high voltage electronics might bring, and is thus more comfortable working with 24 volts or less, than with 230 volts. However, the inventor might have also built some 230 volts switching systems.



An Arduino

The inventor likes to start projects with unfamiliar electrical subjects and is not afraid of researching new components and systems. Is aware of, and a keen user of colour coding wires.

The engineer: has probably studied electrical engineering or has a lot of practical and / or theoretical experience in electronics. Possesses a thorough knowledge of components, feels comfortable with advanced (multi-page) schematics. Will often help others with their systems. Wants systems to be built properly; does not like improper solutions, even if they work. If the engineer uses Arduino, they will not use the Arduino IDE (programming software), but will most likely program in C or C++.

These different approaches in creating electronics for art also influence the resulting artworks content-wise: the inventor and the engineer (and also up to a certain point the hybrid) can use electronics as a comment on the technology itself. Since they mainly designed the system themselves, they know how it works and can thus build or modify a system in such a way that it becomes a critical view on the medium itself. While the end-user and appropriator might also use electronics as a comment, they will usually not be able to comment on the medium of electronics itself. However their critical art-pieces might still comment on for example societal issues or consumer culture through the use of electronics.

As a generalisation, art-pieces made by an end-user or appropriator often use electronics in an illustrative manner. Whereas the art-pieces from the inventor and the engineer will not just depend on functioning electronics, but they will consciously include them in the meaning of the artwork. The hybrid's art-pieces will end up somewhere between illustrative and inclusive use of electronics.

Based on the different ways that artists use electronics, which I distinguished earlier in this chapter, one can also recognise several types of electronic artworks. I distinguish two main categories: inclusive electrical art and illustrative electrical art. Next to these main categories one can recognise several applications. This is not any definite division, as many of these applications can fall in both categories and I am leaving many art-forms out of this categorisation. However, this categorisation-example of applications might offer an indication of the line of thought posed in the following chapters:

Inclusive electrical art includes: Electromechanical installations, some experimental instruments and sound-producing objects, medium-critical artworks

Illustrative electrical art: Collages, light art, most art-installations that use video-playback equipment

Both: Robots and techno-fetishism: 'Obsession with or veneration of technology, especially fashionable consumer gadgets.' [1.10 - *oxforddictionary.com*]

To illustrate the non-definite nature of this categorisation, I will use my ROC.K project as an example. The ROC.K project (2015) consists of different types of rocks found on three locations in Finland. A rectangular hollow is carved into one side of the rock. This hollow symbolises a window through the outer eroded layer. The window resembles a screen of for example a smartphone. However, this screen is not dynamic, it is only a polished image of the surface of a rock. Drawings showing the correct way to hold these rocks are presented together with them. These drawings encourage the audience to hold the rock while looking at the static rock-screen, thus commenting on the way that people eternally stare at smartphone screens, while no relevant information might be transferred. The ROC.K project



was presented as a series of gadgets, including a catalog, posters and a 'sales-presentation'. One could categorise it as a non-electrical art-piece that refers to and criticises on electronic equipment. ROC.K makes a crude comment on the excessive use of screens, by referring to the image of a screen in a non-technological material: rock.

Within my own artistic practice I generally aim for an inclusive use of electronics, as I try to describe in my artistic statement:

'Marloes van Son builds systems, installations and instruments. The electromechanical objects that she develops, explore natural phenomena and everyday appliances. By repurposing ordinary objects, she aims to create unusual, yet familiar experiences. Many of her works start from a visual component, but sound is always an integral part of the eventual piece.'

Conclusions about art and electronics

Following from this chapter, the electronic art-field is defined as a slightly old-fashioned sub-form of new media art, which uses electronics as a medium to explore systems, functions and technological possibilities.

It's nearly impossible to make general claims about the nature of art that uses electronics, as there is no coherent basis. However, two main groups of electrical art can be distinguished:

1. art for which the electronics are inclusive
2. art for which the electronics are illustrative

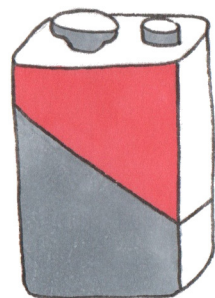
These two groups are based on different approaches that artists have towards using electronics:

The end-user is interested in the result, not the electrical system itself and generally creates illustrative electronic art.

The appropriator uses basic consumer electronics that are 'plug-and-play' to create mainly illustrative electronic art. The hybrid has limited knowledge of the way electronics work and produces something in between illustrative and inclusive electronic art.

The inventor is a curious explorer, who has basic knowledge of components and schematics. Creates mainly inclusive electronic art.

The engineer has a lot of experience in electronics and a thorough knowledge of components. Produces inclusive electronic art.



2. Out-of-order art

From time to time I encounter out-of-order or non-functioning artworks within exhibitions. Some of these art-pieces were more obviously broken than others. The defects ranged from a broken lightbulb or LED, to malfunctioning motors, an unplugged display, to complete system failure. Sometimes these pieces were removed from the exhibition. A sign would then inform the visitors that the artwork was (temporarily) removed from the exhibition. But more often than that, the art-piece remained in the exhibition with a note stating that the artwork needed repairs, while silently reminding a visitor of what electronically powered output it might have produced.

I often describe my artistic practice as an exploration of systems. Some of these systems work better than expected, and others break down soon after a piece is installed. By (mis)using technology, one cannot exactly know how long an art-device will last. I have been fighting against wear and tear. Whenever an artwork seemed to malfunction, I would obsessively try to repair it by replacing parts or altering things. I now realise that technical artworks don't necessarily have to function forever. Technology expires, gets replaced, becomes obsolete and apart from that the ideas and aesthetics of an art-piece might not last either. [2.1 - van Son, 2017]

What is out-of-order art?

'New objects become old objects faster than ever before. The waste and expense of having to replace everything in your life after just a few years of use is exasperating.' [2.2 - McLellan, 2013, p10]

'It fascinates me that that older objects were so well built, and were most likely put together by hand. These items were repaired when broken, not discarded like our devices are today. Older objects were created to give people service and enjoyment for many years, but the new technology that replaces them will itself be replaced even more rapidly.' [2.2 - McLellan, 2013, p10]

Electronic objects break all the time. We are used to replacing our smartphones, computers and home appliances every few years. Often, we do not even attempt to repair them, but replace them as soon as they start malfunctioning or become out of fashion. Electrical art faces the same difficulties, without proper maintenance, these art-pieces soon become non-functioning relics, only vaguely referring to their possible functioning state and meaning.

Electrical artworks have a more straightforward functionality next to their aesthetic content. Most electrical art-pieces are dependent on some functioning electronic components, devices or appliances, such as motors, screens, light or sound equipment. These parts can break and lead to an artwork which seems to be in correct physical condition, but misses a functioning mechanical or electrical element. Without this element the message of the art-piece is often lost, which leads to it becoming an out-of-order artwork. I often find it painful to see a clearly non-functioning art-piece presented in an exhibition. Especially when one considers that most visitors to museums will not recognise the art-piece as broken. As an artist who works with technology I often try to imagine what a non-functional piece could have done. By tracing power connections, identifying actuators and relating those to existing appliances I can

often construct my own interpretation of a possible functioning state. Even though I think that artworks presented in exhibitions should be in a functioning state, this speculative imaginary functionality has offered me some valuable experiences. Trying to imagine how an art-piece could work combines creativity with technological insight and often sparked new ideas. This is something that I wish a more general audience can also experience. It seems that many visitors ignore broken objects, as it is not deemed appropriate to intentionally engage with something imperfect in a museum or gallery-context. However, claiming this would need further research.

In short, out-of-order art is all art that does not function properly in a technological sense, whether that means it is physically broken, functions as the artist intended or encounters problems through wear and tear or obsolescence.

In the following paragraphs I will mainly focus on the function electrical components fulfil within art-pieces.

The functioning artwork

Art presented in an institutional context is often considered to do 'what it's supposed to do', since it is presented in an official venue. As visitors might not know about the artist's intentions, or the way the art-piece was conceived, the state in which an artwork is encountered is thought of as the artwork in its perfect functioning state. Defects in art are hard to address since they might be intentionally designed as such by the artist, thus making it hard to even recognise a non-functioning component in an exhibited artwork. With electrical art, recognising a defect can be easier, as a functioning component is related to a function outside of the artistic context. Which means that this function does not only serve the aesthetic value, but also creates a more straightforward output, for example a movement, or sound. However, usually only visitors who are familiar with the artist, or people who are familiar with electrical art might become aware of an art-piece malfunctioning. The easiest way to notice an issue, is when you have encountered that same artwork before and recognise a difference in behaviour of the piece.

Some signals that an artwork is not functioning correctly could include:

- Unplugged power cables
- Lamps or LEDs that do not produce light
- Gears, hinges, moving or movable parts producing loud squeaking sounds due to excessive friction
- A nervous artist or staff-member checking the art-piece every few minutes to see if it still works

A non-functioning electrical artwork poses a problem, as it is now incomplete and will often lose a large part of its meaning. For example: If some electrical component of an artwork is no longer functioning, one could compare that to a painting where the colour red is no longer present. Everything would be fine, if the colour red wasn't used in the first place; there would be no difference. However, in case the whole painting was originally red, the work itself does no longer exist, nor does it hint towards its former appearance (unless it is a conceptual work of course, or the title would be something like 'the formerly red painting'). If the colour red only covered a small area of the canvas, the original idea, concept or image might still be recognisable, however it will likely look odd when comparing it to the rest of the artist's repertoire.

Sarah Cook proposes a slightly different analogy of this issue in her essay 'Immateriality and its Discontents'. Related to the inseparability of the distribution method from the work's content she writes:

'Net artists often respond to the failure to understand this unbreakable link by asking the question whether one could "peel" an image from a painting and sell it on a postcard as the original.' [2.3 - Cook, 2008, p45]

Paul DeMarinis, an artist and inventor working between art, music, invention, technological archeology, and social commentary, stated the following on how his creative process is based upon working technology:

'I must admit that many of the technologies in my pieces did not exist when I set out to make them. I have had to invent them. It is an important requisite of my art that the pieces actually work. I wouldn't be comfortable with a piece that created an illusion by conventional means. For me the real illusions are the ones that still mystify even when the technology is revealed and explained.' [2.4 - Wilson, 2002, p399]

The artistic-inventor-mindset that Paul DeMarinis describes is an important factor for artists that work with electronics. Such artists spend a large part of their time designing a system, testing this system and eventually improving it. This approach exemplifies how important it is for electrical art-pieces to function. As the artist did not just spend time creating an aesthetic object or experience, but has spent at least the same amount of time on the functioning of the artwork.

Reasons of non-functionality

Several reasons can be identified as to why an artwork is not functioning properly:

- The unfinished art-piece is fairly common, although often camouflaged. The artist did not plan far enough ahead and thus did not have the time to properly test or even finalise the artwork. This type emerges at the beginning of an exhibition.
- The mechanically worn-out artwork works perfectly fine at the beginning of the exhibition -survives the opening- but slowly gets worse over time.
- Technical failure can happen either because of design-flaws or due to unforeseen or unexplainable causes. It might happen at any point during the creation and presentation of the art-piece.
- An artwork can become non-functional due to misuse or misbehaviour by the audience. This will happen during an course of the exhibition.
- The technologically obsolete art-piece can occur when an artwork is exhibited after it has been in storage for a long time. Certain parts may have become disfunctional due to for example outdated filetypes, cable-connectors that are no longer in use, digitisation of (control)signal, or old equipment in general.

Strategies for out-of-order electronic art

The key to creating a functioning artwork is thorough testing. Which means that an art-piece has to be finished quite some time before the exhibition starts. Usually the first exhibition of an electrical artwork serves as a testing phase; many artists are relieved when their contraption survives the opening night. Often the artist can be found at the exhibition the day after the opening to fine-tune all the things that might cause trouble.

William A. Real gives the following example for repairing an art-piece that relies on electrical components in his paper 'Toward Guidelines for Practice in the Preservation and Documentation of Technology-Based Installation Art':

'Keith Tyson's (b.1969) piece, AMCHII-XLII Angelmaker Part II (the quadrupled) (1995, Collection of Pamela and

Richard Kramlich (Ross et al. 1999), includes a vacuum cleaner motor that periodically turns on, creating a distinctive sound and air turbulence, though the motor itself is not visible to the viewer. When the motors burn out and replacements are unavailable, they could theoretically be replaced with components that mimic or emulate the sound and air turbulence produced by the original equipment. As long as such an intervention is documented and theoretically reversible (at the extreme, someone could construct a new motor from scratch, for example), it is probably appropriate since the viewer's essential experience of sound and air movement is entirely preserved.' [2.5 - Real, 2001]

Based on the different approaches that artists have towards using electronics that were identified in the previous chapter, one can formulate different strategies for repairing a broken artwork:

- The end-user will often not be able to repair the electronics in the artwork by him/herself. Depending on who built the system, repairs might be easy or complicated. If there are custom built elements, one is dependent on the documentation provided by the person who originally built it. This documentation however, is often not present. Thus the original creator of the system has to be the one who does the repairs. If the electrical system can be replaced by a different module that has the same result, this will be a viable option.
- The appropriator: repairing a system built by an appropriator will be rather easy, as the parts for replacement can often be found in a common hardware store.
- The hybrid: if the hybrid is a messy worker, the electrical system will require a lot of effort to repair for both the builder him/herself and any other person. If the system is neatly built, modules should be relatively easy to replace.
- The inventor: will differ quite a lot between cases. Some might be extremely hard to repair, since the built systems can be rather dodgy, as the inventor likes to figure out the electronics mostly by him/herself, or mess around until they find something interesting. These systems will most likely have to be repaired by the inventor him/herself. Unless they provide proper documentation.
- Engineer: the electronics built by the engineer can be repaired by any other engineer, as thorough documentation should be easy to provide, due to the systematic way of working that the engineer incorporates.

When an artwork becomes out-of-order there are a couple of options that the artist or exhibiting party has:

The first and most obvious option is of course to fix the piece. Sadly this is not always possible. The art-piece could also be removed from the exhibition. This is desirable when the artwork is in such a state that it cannot be fixed in a satisfactory manner during the course of the exhibition. An artwork in this state might also negatively influence the opinion of the audience about other works presented in the same exhibition, thus it might be better to remove it. Another option would be to fake the desired outcome of the electrical components of the art-piece. This is for example possible with some sound-contraptions. When the original system does not provide the desired outcome, one could for instance play the sound from a media-player to approximate the functioning art-piece. This will not work in every situation, and will of course alter the piece, so some artists are very much against faking functionality. The final option is to present the piece as a work in progress. This can be achieved by adding sketches, documentation, (functioning) prototypes, ideas, texts or clarifications, so that the viewer has a chance to imagine how the artwork might have worked, while at the same time creating a situation where the audience understands that this is not the way the artwork was supposed to be functioning.

It is important to note that 'any intervention - such as replaced components, parts, or media - will change the piece in some fundamental way, a concept that applies equally to works of art in more conventional media.' [2.6 - Real, 2001]

Conclusions about out-of-order art

Out-of-order art is all art that does not function properly in a technical sense, whether that means it is physically broken, functions as the artist intended or encounters problems through wear and tear or obsolescence. A non-functioning electrical artwork poses a problem, as it is now incomplete and will lose a large part of its meaning.

Many broken artworks are not recognised by the audience as such. However, when an art-piece is recognised as non-functional, visitors tend to ignore it. As an artist who works with technology I usually try to imagine what a non-functional piece could have done. This speculative imaginary functionality has offered me some valuable experiences, by sparking ideas through a combination of creative and technological insight. I would like to offer a similar experience to an audience, but this would need further research.

Many artists working with electronics spend a large part of their time designing, testing and improving the system that is incorporated in the artwork. This means that it is important that the art-piece is in a functioning state while being exhibited, as the artist did not just spend time creating an aesthetic object or experience, but has spent at least the same amount of time on the electronic content of the artwork.

Artworks can be or become non-functional due to several reasons, being:

- the art-piece is not finished
- the artwork is mechanically worn-out
- technical failure
- misbehaviour of the audience
- technological obsolescence

When an artwork is out-of-order and needs to be repaired, one needs to take into account that the different styles that artists employ for creating electronic art-pieces influence the repair-strategies. Finally, when an artwork can not be repaired one can choose between removing the art-piece from the exhibition, faking the desired result and presenting the piece as a work in progress.



COLC-undrown (2013)

3. The lifespan of electronic art

My installation COLC-undrown (2013) consists of a custom-built large scale whirlpool that creates light projections which changes over time. The mechanics of the piece are based on small electrical stirring devices that are commonly used in chemistry. These stirring devices consist of a rotating magnet under a platform on which a vessel filled with fluid is placed. A magnetic stir-bar is placed inside the fluid-filled vessel. The magnetic stir-bar follows the motion of the rotating magnet below, this rotating motion creates a whirlpool inside the fluid. The large-scale vessel that I used was made out of plexiglass. At the time I did not realise that the continuous stirring motion would slowly erode the bottom of the plexiglass vessel that I used. The erosion created a small concave hollow at the very centre of the whirlpool. The stir-bar was turning on top of this hollow and would slowly experience more and more resistance, until the whole installation did not function any longer. I noticed the unintended change in movement over time and became increasingly stressed about the workings of my installation. However, during the exhibition, nothing could be done about it. Afterwards I redesigned the whole stir-bar mechanism. It now has a fixed rotational point with a bearing in the centre of the whirlpool. The bearing can be easily adjusted or replaced and the erosion-trouble has since been absent. [3.1 - van Son, 2017]

Is there such a thing as a lifespan of electrical art?

A sculpture can last for a very long time in a state that more or less resembles its original appearance. Paintings might last for generations, until the paint fades, the frame breaks, or it suffers from environmental damage. As soon as an artwork incorporates some electronic component, its lifespan decreases drastically. When art is designed to produce a certain movement, sound, or other process that requires technological aid, it might stop functioning at some point due to wear and tear, malfunctioning or technological obsolescence.

Technological obsolescence refers to the mechanism that replaces old technological devices with newer versions, thus rendering the old version useless. Obsolescence is not always a negative process. It is partly a by-product of technological advances; when something better is invented, the old version is no longer relevant. It influences electronic art as described in the following quote from 'Toward Guidelines for Practice in the Preservation and Documentation of Technology-Based Installation Art':

'(...), technology-based installations generally include material that is either inherently ephemeral or subject to rapid obsolescence, or both, such as machine-readable media that provides much of the sensory experience of the piece. Examples include videotapes, laser discs, DVDs, color slides, and film and the corresponding playback equipment such as video and disc players, cathode ray tube (CRT) or liquid crystal display (LCD) monitors, amplifiers, speakers, projection screens, computer equipment, and video, slide and film projectors.' [3.2 - Real, 2001]

This greatly affects the longevity of electronic art, as *'maintaining the functionality of hybrid installations that may combine equipment no longer commercially manufactured with data in obsolete media may be the ultimate preservation challenge.'* [3.3 - Smithsonian institution, 2010, p9]

The following question arises: Can timeless technological or media-artworks exist? Stephen Wilson, the writer of 'Information Art: Intersections of Art, Science and Technology' asks a similar question. He states the following:

'The rapid pace of research is part of developments in the industrial age that clash with the hopes for art's timelessness. In the past, masterpieces were expected to transcend time and space. During this century, that tradition has been eroding with the loss of "aura" in technologically reproducible work, the ascendance of temporary art forms such as live art and installation, and the power of style and media to rapidly reshape consciousness. Nonetheless, as evidenced by the activities of museums of modern art, many hope that even contemporary art can produce timeless masterpieces.' [3.4 - Wilson, 2002, p30-31]

Concluding from this, one could say that timeless masterpieces in technological art have not yet emerged due to the relatively short time that new media art has existed. However, with the right preservation, conservation and documentation strategies these timeless masterpieces will most likely come into being and survive imminent technological breakdown.

The survival of timeless new media masterpieces will only happen when curator, artist and audience work together and adapt to the demands of the art:

'As an inherently process-oriented and participatory art form, new media art has a profound influence on the roles of the curator, artist, audience, and institution. Increasingly, curators must work with the artist on development and presentation of the work. The artist often becomes a mediator and facilitator - for collaboration with other artists and for the audiences that interact with and contribute to the artwork. In new media art, the traditional roles of curators and artists are being redefined and shifted to new collaborative models of production and presentation. The public and audience often participate in the artwork - a role that runs counter to our idea of the museum as a shrine for contemplated sacred objects. All these issues require that art-institutions, at least to some extent, reconfigure themselves and adapt to the demands of the art.' [3.5 - Paul, 2008, p2]

Artists working with electronics, or even technology in general have several factors to take into account when producing and exhibiting artworks. As an example, when installing a painting in a gallery, the person installing has to keep the following in mind: general position within the space (where in the space does the painting fit best), the attachment point on the wall (nails, screws, hanging rails) and lighting of the piece (facilities for this are usually present in a gallery). When these three steps have been completed for all the artworks, the exhibition is more or less ready. An artist building up an exhibition that includes electrical art-pieces has to carry out the previous three steps, while also having to install power cables to the piece (and trying to make the cable-situation look as good as possible), assemble the art-piece (mainly for larger, more complicated works), and after assembling the art-piece has to be thoroughly tested, as the situation in the gallery might be different from the artist's studio.

Due to these extra factors that play a role with electrical art-pieces, not just during installation, but also in for example maintaining them, one could expect that the expected lifespan of electrical art-pieces is shorter than that of artworks made in more classical techniques.

Conservation and preservation strategies

In an idealised world an institution and artist would feel equally responsible for maintaining the integrity of an art-piece. They would do so by consciously and carefully carrying out repairs on broken electrical artworks, preferably in

collaboration with each-other. Artists should take initiative in providing the necessary documentation to institutions, since not every institution is aware of the risk that negligent repairs cause to the integrity of an electronic art-piece. As even changing a small technical detail in an electronic artwork might change the meaning of such a piece significantly.

Curator of new media arts Christiane Paul writes in 'New Media in the White Cube and Beyond, Curatorial Models for Digital Art' that:

'Museums, galleries, and the art world have long been oriented mostly toward objects and have configured themselves to accommodate the presentation and preservation of such static works of art. The so-called new media art, an increasingly important part of contemporary artistic practice, challenges the traditional art world - its customary methods of preservation and documentation, as well as its approach to collection and preservation.' [3.6 - Paul, 2008, p1]

In his paper on preservation and documentation of technology-based installation art William A. Real is concerned about the limited experience that the conservation field has *'dealing with the preservation of ephemeral physical components of many technology-based installations, such as electronic media and playback equipment, without there is no hope of recreating a piece in the future.'* [3.7 - Real, 2001]

Also the Smithsonian Institute addressed the need for careful planning and budgeting related to long term maintenance when acquiring time-based new media artworks in a conference organised in 2010. [3.8 - Smithsonian Institution, 2010, p6]

Luckily institutions seem to become increasingly aware of the careful treatment that electrical and technological art-pieces require, based on the large number of papers that have been written and conferences that have been organised on the subject of preserving and conserving time-based electronic arts. Recent events include:

'Conservation Piece(s) - Conference on the preservation of performative media' organised in Haus der elektronischen Künste Basel on June 27, 2016

'Preserving Moving Sculptures - Between Material and Ephemeral' a conference organised by the Summer Institute in Technical Art History, Conservation Center at the Institute of Fine Arts, New York University on June 13, 2013.

'New Media in the White Cube and Beyond: Curatorial Models for Digital Art' a book edited by curator of new media arts Christiane Paul and published in 2008

Documentation for electronic art-pieces

An encounter with the drawing 'Nuclear telephone discovered in Hell' (2003) by Abu Bakarr Mansaray at the Venice Biennale of 2015 sparked my interest for artistic documentation of electronic art-pieces. This artwork shows a beautifully detailed drawing of an imaginary device. It made me think about ways to include technical documentation for my electronic devices into the artwork itself. However, my documentation drawings would not be imaginary; they would show the actual electrical schematics of my art-devices.

William A. Real (Ex-chief conservator of the Carnegie Museum of Art in Pittsburgh) proposes that the following elements could be included in documentation of technological art-installations:

'Depending on the installation, documentation might include floor plans, schematics, wiring diagrams, lighting diagrams and reports, artists' preliminary notes and sketches, photographs, video, video interviews of artist, curator, and others (Mancusi-Ungaro 1994), written records of those involved with the installation, instrumental characterization of video and audio levels and quality, computer-assisted design (CAD) files, and virtual reality (VR).' [3.9 - Real, 2001]

Many institutions seem to agree that artists are generally not capable of (indefinitely) providing documentation for their art-pieces:

'Given that artists will not be available indefinitely to answer questions about the meaning, preservation, and display of their work, it is advantageous, when possible, to create a primary source record of artists' intentions at the time of acquisition. For example, what is fundamental to the artwork to maintain its integrity?' [3.10 - Smithsonian Institution, 2010, p6]

'It is almost never practical to expect the artists to fulfil this role (of providing documentation of their art-piece) even though they alone may be party to every key decision along the way.' [3.11 - Real, 2001]

In my opinion these institutions are only partly right in believing that artists are incapable of providing sufficient documentation. Based on conversations with my peers, the following often happens in the process of art-production: As soon as (the prototype) of an art-piece is finished, the artist loses interest. This means that even documenting the artwork during an exhibition takes tremendous effort. Especially since the build-up period leading towards an exhibition is often exhausting and stressful, producing visual documentation might simply not happen. This mechanism seems to be even stronger in the production of technical documentation, which is only rarely produced. The absence of technical documentation threatens the longevity of an electrical art-piece and thus institutions are slowly starting to address this issue.

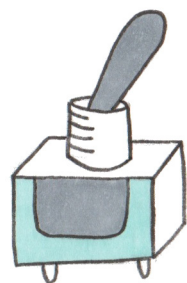
Proposals from institutions to solve this lack of documentation range from appointing a documentation coordinator during the installation process, to including short essays addressing the artist's intent and aspects of long-term preservation in exhibition catalogs [3.12 - Real, 2001], to having artists fill out questionnaires [3.13 - Smithsonian Institution, 2010, p6]. However, the main responsibility with these proposals lies with the institution, instead of with the artist. Even though institutions will eventually be the ones initiating repairs and maintenance of an art-piece, artists should take part of the responsibility in providing initial documentation, since it is also in the artist's benefit to keep an art-piece in functioning condition. This means that artists should start to consider the production of technical documentation as part of their profession.

Conclusions on the lifespan of electronic art

Artworks incorporating some electronic components seem to have a shorter lifespan than conventional art-pieces. Due to the additional factors that functioning electrical artworks impose and the influence of technological obsolescence, the expected lifespan decreases.

Timeless masterpieces in electrical art have not yet emerged due to the relatively short time that new media art has existed. However, with the right preservation, conservation and documentation strategies timeless masterpieces will most likely come into being and survive imminent technological breakdown.

Artist and institution should both take part of the responsibility for documenting and repairing artworks, while maintaining the artistic integrity of a work. Proper documentation of electronic art-pieces ensures that they will remain in a functioning condition in the future. However, institutions seem to be doubtful whether artists are capable of providing this. Meaning that artists should take more initiative in providing initial documentation for their electronic art-pieces.



4. Electronic art-devices, instrument building and composing

'Wherever we are, what we hear is mostly noise. When we ignore it, it disturbs us. When we listen to it, we find it fascinating. The sound of a truck at fifty miles per hour. Static between the stations. Rain. We want to capture and control these sounds, to use them not as sound effects but as musical instruments.' [4.1 - Cage, 1937]

Defining art-devices

Taking this statement of John Cage literally, I formulated the idea of an art-device. Art-devices can be defined as objects that produce light, sound or movement. They can be composed with, controlled or influenced by a user. With art-devices, the electronics have to be an integrated element. One could say that the electronics are the content or medium. Without functioning electrical components the device will degrade to a static object and lose its full meaning. This means that art-devices possess a sort of non-functional functionality: they have a certain function, but not necessarily a useful one. An unused and no longer functioning art-device is like an empty shell. It retains some of its former meaning, but no longer does it live up to what the maker intended. [4.2 - van Son, 2017]

The idea of John Cage to turn everyday sounds into instruments is not new. The Futurists had similar ideas in the early 20th century. In 'The Art of Noise' a Futurist manifesto from 1913, Luigi Russolo *'opposes the "noise" that is the raw material of his music, with the "pure sound" that is the raw material in classical music. "In the roaring atmosphere of major cities," maintains Russolo, "the machine... has created such a variety and rivalry of noises that pure sound... no longer arouses any feeling.'* [4.3 - Ostashevsky, 2015, p5]

Joel Chadabe writes in 'The History of Electronic Music as a Reflection of Structural Paradigms' that:
'the two most important developments in the history of electronic music were (1) the opening up of music to all sounds and (2) the development of interactive instruments.' [4.4 - Chadabe, 1996, p41]

Some of my art-devices appropriate commonly available electronic components as sound sources for instruments. For example my device RESO makes use of the resonating frequencies of a stepper-motor as if it were a tone generator. These particular motors produce a rich tonal spectrum and are commonly used in printers, which gives a listener a point of recognition in an unfamiliar sound-device. (For more information about RESO see appendix 1.1) In general art-devices can be seen as a separate category in electrical art, since they are not only dependent on working electronics, but also on a user or performer. Art-devices approximate the reactive branch of interactive art, as interactive art also includes the audience as an actor in the eventual experience. However, art-devices add a musical layer to the reactive component, effectively turning them into artistic instruments.

The practice of artistic instrument building

Art-devices are closely related to instruments, referring to both the musical and scientific kind. The Merriam-Webster dictionary defines 'instrument' as:

1. a tool or device used for a particular purpose; especially : a tool or device designed to do careful and exact work
2. a device that measures something (such as temperature or distance)
3. a device that is used to make music [4.5 - Merriam-Webster]

Additionally Sergi Jordà states the following: *'Musical instruments are used to play and to produce music, transforming the actions of one or more performers into sound.'* [4.6 - Jordà, 2004, p321]

Finally new electronic instrument designer Bert Bongers gives the most narrow definition of musical instruments: *'Musical instruments are extreme examples of precise, expressive and versatile interfaces. With the transition to the use of electronics as a sound source, a new type of non-mechanical instrument was needed.'* [4.7 - Bongers, 2007, p9]

From this follows, that an instrument is a specific kind of device, which includes an interface. Instruments produce something, whether that is data or sound (which is a kind of data), or it enables production in the form of a tool. An art-device logically also produces something, but that something is much harder to define. In my opinion, art-devices produce a different view of an ordinary object. The main difference with a musical or scientific instrument is, that an art-device does not necessarily produce something predictable. Where keys on instruments produce predetermined tones, art-devices do not have to follow that same logic. The intention of an art-device is after all, to spark a thought, divert the mind, or create something unusual. Although an art-device should be used by an audience or performer in order to reveal its potential, they don't have to be user friendly. Sometimes the struggle of a user will enhance an underlying idea. [4.8 - van Son, 2017]

This unfriendly user-interface can be recognised in my Rick-device. Rick is a rock with toggle-switches, a potentiometer and a linear-fader, which are carved into its surface. Inside the wooden box underneath the rock are the electronics that produce the sound. Even though I provide a user-manual for Rick, it seems to be notoriously difficult to use. The switches do not always trigger a similar response. Every once in a while flicking a switch will completely silence the sound. On other moments the triggered sound-change is far from what is expected. I usually introduce Rick as a moody instrument with an unpredictable personality; it seems to have its own will. (See appendix 1.5 for more information on Rick)

Artistic instruments are interesting, because next to their musical abilities they serve a different kind of artistic function. Instruments are somewhere between art and design: on one hand they serve to produce music or sound, but they also possess a strongly visual, or design component; a reference to current gadget culture. The interface of an instrument strongly influences what sort of music or sound can and will be produced with it. To relate this to one of my own devices: Phynth is in essence a synthesiser that produces telephone sounds (the name Phynth is short for: PHone sYNTH). In the final design I also included sine- and square-wave sounds in a classical major scale. While playing with Phynth myself and observing others when they would be playing, I noticed that people came up with rather interesting melodies. A classical piano-keyboard invites for playing scales, which I attribute to the linear lay-out of the keys. Since the keys of Phynth are placed in a numbered 3 x 4 grid, a player naturally jumps between less common tone combinations. Another benefit of this numbered 3 x 4 grid-layout is that a player does not have to be able to read notes to create a score, he / she can just write down the numbers corresponding to the tones and thus easily

reproduce a melody. (See appendix 1.4 for more information on Phynth)

In this sense a division between classical instruments and new instruments varies significantly. Computer-based interactive music system designer Sergi Jordà describes this difference in 'Instruments and Players: Some thoughts on Digital Lutherie'. He states that many classical instruments such as the piano or violin have a high diversity and variability, whereas many new instruments are highly specialised and can only be used for very specific types of music-compositions. [4.9 - Jordà, 2004, p335] The high diversity and variability of classical instruments may contribute to its long-term popularity.

Sergi Jordà also describes a dichotomy in interactive music systems. He makes a distinction between systems that were conceived for trained musicians and systems that should be controlled by members of an audience during public performances:

'The demands for the two genres are usually very different. Complicated tools which offer great freedom can be built for the first group (trained musicians), while the second group (audience members) demands simple, but appealing tools that must produce "satisfactory" outputs, while at the same time giving the users the feeling of control and interaction.' [4.10 - Jordà, 2004, p331]

One of my approaches to create accessible, playable, approachable, yet musically interesting instruments is by appropriating common interfaces for musical control. As with Phynth, where a telephone dial-pad is used to trigger tones that refer to analog telephony systems. (See appendix 1.4) Or by using humorous and attractive looking objects as interface, as I attempted with Rick. (See appendix 1.5)

One thing that I have noticed, is that instruments with less controls, or more straightforward controls seem to be more popular with first time users. Those are simultaneously the instruments that I avoid using during my sound performances as they seem less musically versatile in their use. This connects to the principle described in the following quote by Sergi Jordà from 'Instruments and Players: Some thoughts on Digital Lutherie':

'(...), some instruments are indeed more powerful, flexible or versatile than others. Some are vocationally generic or all-purpose while others are highly specialised. Some take years to master, while others can be played by amateurs or even by complete novices. Some become toys after ten minutes (or two hours), while some 'good' ones manage to capture our attention and squeeze our attention for decades.' [4.11 - Jordà, 2004, p326]

Composing for art-devices

'Traditional instruments can be played with a score (i.e. the player's actions on the instruments can be notated), but except some rare cases (like the pianola) they do not embed these scores. But new digital instruments do not have to be scoreless. Time lines of different kinds can be embedded in them, which may allow to control everything from subtle parameters nuances to a whole piece, either fixed in time (scored) or dependent on other events.' [4.12, Jordà, 2004, p324]

Even before starting to build art-devices and instruments, I was already creating scores for the movements that my kinetic installations made. I refer to these changing movements over time as compositions, in much the same way that a composer would speak about a musical composition. Most mechanical movements produce some sort of sound,

whether intentional or not. In order to fully integrate electronics in my art-pieces, I also had to embrace its side effects, such as sound created by friction or pulse-width-modulation. With my art-devices I specifically try to use the sonic qualities of mechanical movement, by building interfaces for electromechanical components and manipulating movements to create experimental sound-compositions.

One of my main instruments at the moment is Cardbox, a digital oscillator with variable parameters. Within the programming for CardBox, I included a small random delay, so that turning a knob would not lead to a direct reaction in sound. I did this to invoke an unexpected surprise, something that a performer would have to play with. Or, as Joel Chadabe puts it in 'The History of Electronic Music as a Reflection of Structural Paradigms': *'The expected, after all, is often boring.'* [4.13 - Chadabe, 1996, p43] Following his thoughts I wanted to give the instrument a mind of its own, *'such that it produces musical information that contains surprises.'* [4.14 - Chadabe, 1996, p44]

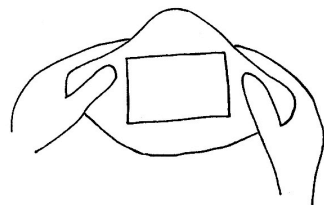
My written scores only include notations for presets, but no notation for timing is added, thus the one performing the composition needs to feel the situation and determine the appropriate timing as his / her own input. Since the art-devices can be rather unpredictable as instruments, these notations of presets are essential for creating coherent musical compositions and performances. (For examples of these scores, see appendix 2). As my goal with these performances is to create enjoyable musical experiences instead of just demonstrations of the sonic abilities of the devices.

Conclusions on electronic art-devices, instrument building and composing

The idea of an art-device originally came from a quote by John Cage, where he expresses the desire to turn everyday noises into instruments. Art-devices are objects that produce light, sound or movement and can be composed with, controlled or influenced by a user. The electronic component is the medium of an art-device and thus produces its meaning. Without functioning electronics the art-device does not exist as an instrument. Similarly an instrument turns into a non-musical object when it no longer functions. The art-device is closely related to a musical instrument, but where an instrument creates pre-determined tones when played, the output that an art-device produces does not have to follow a logical structure.

Where trained musicians enjoy to use sophisticated interfaces, a novice user often prefers a simple and appealing tool that gives a user a feeling of control and interaction. However, these simple interfaces offer less musical diversity and variability.

Scores are essential tools for creating musical compositions for both classical and new experimental instruments. Especially for new instruments that include a random factor, notated presets form an important part of a coherent performance.



ROC.K

Poster design for the ROC.K project

5. Theory applied to my own devices

I developed art-devices as a practical exploration of the role of electronics in art and out of curiosity towards how appliances, systems, and electrical objects function. My art-devices are greatly dependent on the quirks of electrical components, which means that I cannot always influence the way these devices function or how they keep on functioning over extended stretches of time. In this chapter I will not introduce any new concepts. Instead I will relate the concepts that I have written about in previous chapters to my 'Devices-project': Some theory imposed on my art-devices.

The development process

I started developing art-devices out of curiosity towards how appliances, systems, or electrical objects function. I have always been curious about how things work. My way of finding out how something works, is by building my own version. The process of building my own version starts with an in-depth investigation through reading and copy-pasting text fragments into enormous compilations of information about a certain topic. Once I understand the essence of a system, the next step is to design a simplified or altered version. After which I build a prototype using electronics on a breadboard, cardboard and tape. When I have tested the cardboard version of this new interpretation of a system, I build a wooden version. The last step is drawing the technical schematics and developing my own theories and thoughts about how the original appliance functioned versus how my version works versus how they both could function differently: speculating about functionality. The resulting art-device contains components of an original device, but its function and functionality might have completely changed. With this I try to give the user of an art-device a different view on appliances, by trying to make them aware of possibilities; the prescribed way to use an object might not be its only use.

Physical design

My particular interest in appropriating electronics in art and its consequences is as follows: I am interested in the noise of appliances, which I try to emphasise on by amplifying electromechanical sounds and creating instruments from of them. The physical design of these experimental instruments is important, as I want to build objects that are approachable in their experimentalism. As I believe that an audience needs an invitation to explore their own curiosity, especially in an institutional setting. An attractively designed object might just offer this invitation.

I already described another important aspect of physical design in the paragraph 'The practice of artistic instrument building' in chapter 4, where I mentioned the unfriendly interface of Rick and the unconventional tone-layout of Phynth. Unusual and unpredictable interfaces add an extra layer on a sound-device. This layer facilitates creativity for the user and tries to enhance new modes of composition and performance. These thoughts on unusual interfaces started with the ROC.K project. (See also paragraph 'In what ways are artists using electronics?' chapter 1). The carved rocks that form the core of this project are essentially referencing a static version of a common interface: the rectangular touch-screens of smartphones. The ergonomics of smartphone-design trigger a particular posture in a user. The ROC.K-rocks also have a recommended way of holding, which is related to the smooth curves of a par-

ticular rock and the side in which the 'screen' is carved. Next to these shape-determined factors a rock also possesses a certain weight, which influences the length of time that one can comfortably hold it, as opposed to smartphones which are designed to be lightweight and reasonably compact. As an extension of these initially rock-related thoughts I developed Rick, a sound device made from a rock, which makes it uncomfortably difficult to carry it around due to its weight. Not only does the rock that Rick is made of reference 'rock-music', I also believe that the sheer fact that a sound device is made from a rock influences the way that a player uses it.

Building RESO

The building-process of RESO is an interesting example of how the investigation process towards the workings of electronics starts. I have used stepper-motors in several other installations for movement-purposes. While fine-tuning the speed of these motors, I noticed that the resonating frequency changed according to the velocity of the rotation. A sequence of changes in speed would create something that came close to a melody. It even sounded pleasant due to the harmonics that the stepper-motor produced. I wanted to capture and control this phenomenon by turning these resonant frequencies into an instrument. RESO is an early experimental version of such an instrument. It's not yet as pleasant to listen to its amplified sound as I hoped. The balance between high and low frequencies is not yet right. A second, third and probably even more versions will have to be built before I am satisfied with the way it sounds. This connects my artistic practice to that of an inventor: most devices are never truly finished. [5.1 - van Son, 2017]

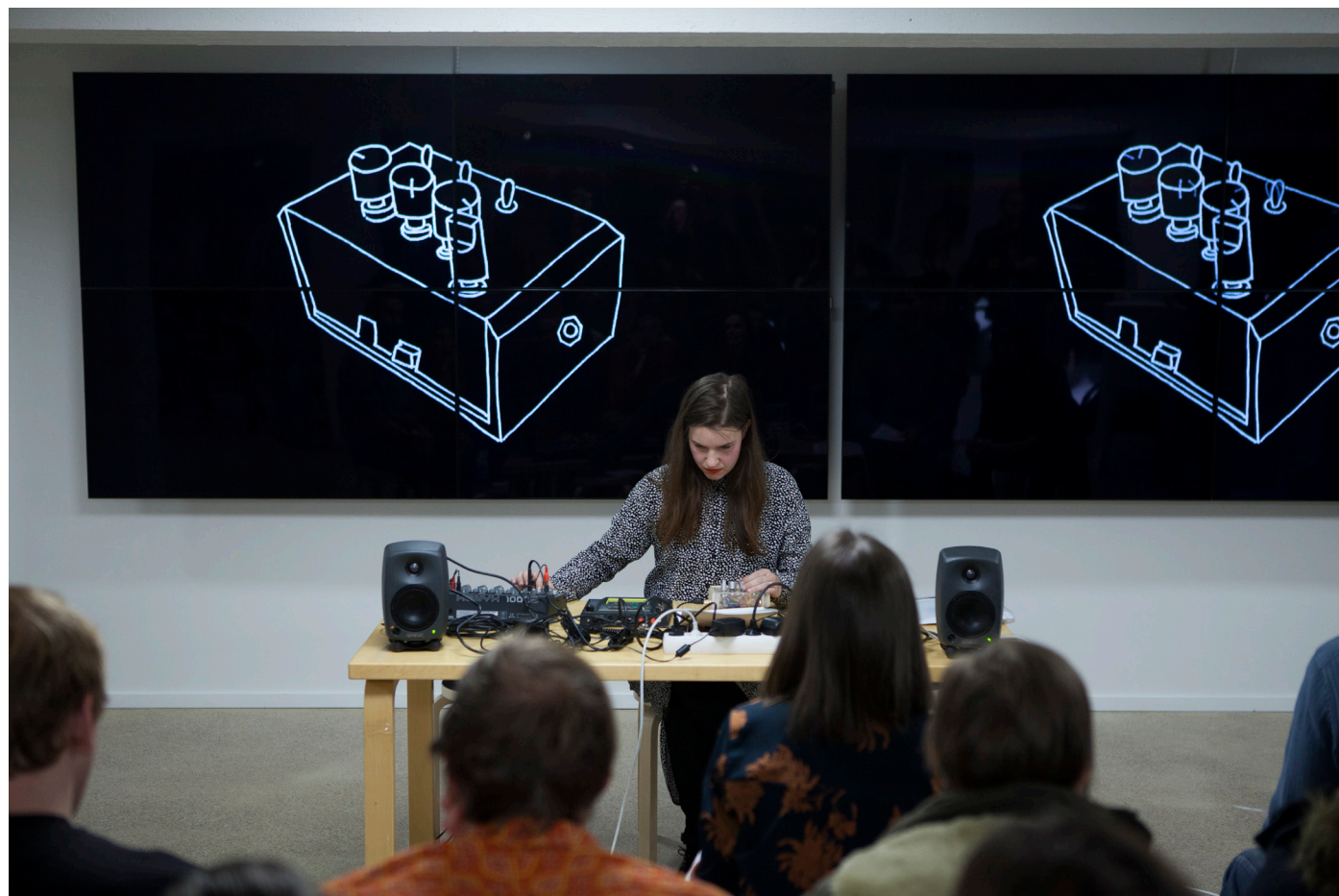
Schematics

One of the underlying ideas for the devices project is opening up the way that electronic appliances function to people who might not have any insight in technology. Drawings of schematics are an important part of understanding electronics within my exploratory practice. However, to someone unfamiliar with electrical schematics they might look rather daunting. In order to create a more accessible format for schematics, I started to include drawings of physical components to the symbols that are commonly used. These drawings of physical components help to clarify the electrical functioning of a device to people who are not familiar with electrical symbols, while also creating a more attractive drawing. As it is not necessary to understand the electrical functioning to enjoy an art-device or its schematics.

These drawings also serve another purpose. As I described in the paragraph 'Documentation for electronic art-pieces' of chapter 3, I think that artists should take more responsibility in prolonging the possible lifespan of their art-pieces through providing initial documentation. By including artistic, but technically (mostly) correct schematics in the project itself I try to create a curiosity towards working electronics, which I hope will trigger a desire for repairing a device when it might no longer be functioning.

User-manuals

Initially the user-manuals that I created for the devices started as a joke. As people do not usually read user-manuals, unless they are desperate and have no idea how to get something to function by just pressing buttons; at that point a user might pick up the manual (see appendix 1). I also hope to convey my own fascination for the workings of appliances to an audience, so that they might gain a different understanding of how something could work. It might even serve as an introduction to underlying thoughts about inventions and engineering: after reading my made-up



*Performance at the Harald Herlin Learning Centre
Picture by Laureline Tilkin-Franssens*

user manual the audience might realise that there is something speculative behind every system. The user manuals could serve as a reminder of how much we take functioning objects for granted and how easily we discard things that are broken. Even though many broken objects can still be repaired or otherwise function slightly or even completely different from its originally intended use with some imagination and modification.

Sound-performances

I write compositions and participate in sound-performances with my art-devices, but I don't see these public events as an ultimate result, showing the final capabilities of the art-devices. For me they are a demonstration of one possible way to use the devices. After experiencing a performance, I hope that audience members feel curious towards exploring the possibilities that these art-devices hold. Giving the audience the opportunity to experiment with the devices creates a possibility to find a completely different way of using them. It might even result in the audience breaking the object.

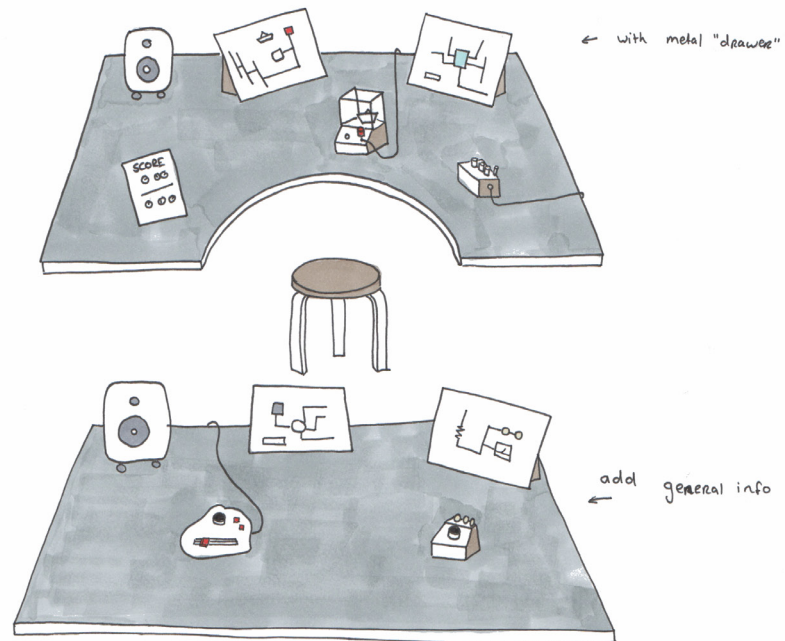
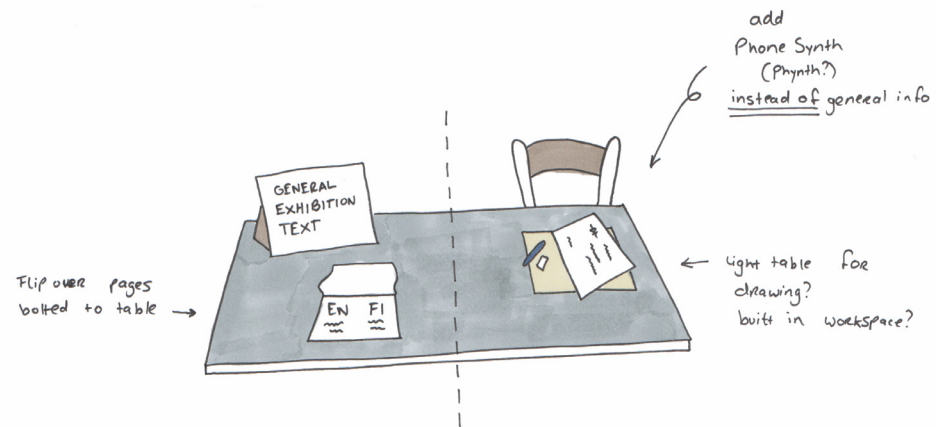
These compositions and performances also serve as a way to create sonically pleasing experiences with unusual sound-generators. This is one of the reasons why I choose not to improvise, as for me it is impossible to create a coherent and pleasant sound-piece without a pre-determined structure.

Animations

One of the sound-performances took place at the Harald Herlin Learning Centre in Otaniemi (Finland). Four large screens were mounted on the wall behind where I would perform. It felt silly to have them display something unrelated during my performance, which is why I created the first animations based on scanned drawings of the devices. These animations complete the devices-project, as it now comprises of physical objects, sound compositions, drawings, technical schematics and moving images.

Summary of theory applied to my own devices

Art-devices came into being out of curiosity towards how appliances, systems, or electrical objects function. The Devices-project tries to convey this curiosity to an audience by offering them attractively designed experimental art-devices and documentation in the form of schematics and user manuals. This documentation also serves as a way to prolong the lifespan of these devices. Sound performances done with the devices serve as a demonstration of one possible way to use the devices and an exploration in creating sound compositions and music with unusual instruments. Finally the animations complement the over-all appearance of the project with moving images.



Out-of-Order exhibition design sketch

6. Case study: interactions of the audience at the Tekniikan Museo

From the 31st of January until the 5th of February 2017 the Tekniikan Museo in Helsinki hosted my exhibition titled 'Out-of-Order'. This exhibition included five art-devices with their respective hand-drawn schematics, user-manuals and a volume with background information. The devices were connected to a sound-system so that the audience could experiment with the possibilities of the experimental sound-objects. This chapter describes my expectations and considerations before the exhibition started and the realisations that I had afterwards.

Exhibiting at the Tekniikan Museo

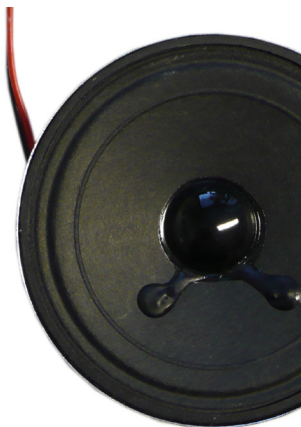
The Tekniikan Museo, or museum of technology in English, presents the history of technology and industry of Finland. It is the only general museum of technology in Finland. [6.1 - tekniikanmuseo.fi] I am generally interested in exhibiting in non-standard art-environments, as I find that the white cube situation of a gallery does not specifically suit my work. Since my art-devices possess both an artistic and technological component, the Tekniikan Museo seemed like a perfect fit for an exhibition. Especially since I assumed that the visitors of the museum would already be in a practical exploratory mood, as technical museums often include interactive exhibits. My art-devices have to be used to reveal their full meaning, so I hoped that by placing my exhibition in the premises of the Tekniikan Museo I would encounter an audience less familiar to art than in a gallery setting, but still open and curious towards using unfamiliar objects.

The layout of the exhibition

The 'Out-of-Order'-exhibition was located in a corner of the Tekniikan Museo that was previously used for storage. Within the layout of the museum the exhibition was placed between the 'Teledreams'-exhibition which presented a historical overview of telecommunication and a rather old-fashioned exhibition about the wood-industry. It was interesting to see how my objects related to both of these. First of all my objects deal with sound, which is an inherent aspect of telecommunication, and Phynth (see appendix 1.4) is even based on the sounds of analog telephony. Next to this all the devices are made from wood.

As for the layout of the exhibition itself, it included three tables:

On the first table, which was located next to the entrance of the space, a book with (technical) background information was placed. Phynth and RESO were standing on this same table, together with the schematics for Phynth, RESO, CardBox and Rick. The second table, which was placed frontally towards the entrance, was custom-made for the exhibition. This table had a semi-circle cut out from the front, which gave the impression of a control-board. In front of this semi-circle a stool was placed. On the table itself Rick and CardBox were located, along with prints of scores which could be played by the audience. On the far corners of the table two small speakers were placed. A small audio-mixer was hidden under the table. Phynth, RESO, Rick and CardBox were all connected with cables to the audio-mixer and speakers, so that the audience could generate sound. A third table was situated on the left side of the space. On this table LAMP and its schematic were placed alongside a workspace with light-table, where I intended to work during the exhibition. User-manuals could be found next to all corresponding devices. The surfaces of three tables and the stool were painted grey to provide a neutral background on which the devices would stand out.



out of order

31.1 - 5.2.2017

Marloes van Son



Tekniikan Museo
Viikintie 1
00560 Helsinki

Avoinna : ti, ke, pe 9-17,
to 9-19, la, su 11-17

Exhibition poster

Including my presence in the exhibition

Within the design for my exhibition at the Tekniikan Museo I had included a work-area for myself, where I was planning to make additional sketches of the exhibited devices. This idea came from the artist residency that I did in 2014 at DordtYart (the Netherlands), where I was working in an open studio together with two other artists. People seem to be generally interested in artistic work practices, so I wanted to include some of that within the exhibition. Being present full-time at the Tekniikan Museo also meant that I had a chance to speak to visitors and give them additional information if needed.

I expected that my presence at the exhibition would be necessary. I had formulated three reasons why I thought this was the case. The first being that the devices needed supervision if I wanted people to use them without breaking them. The devices are not extremely fragile, but could still break due to misuse either accidentally or out of frustration. The second reason was to avoid confusion, as the devices are not exactly logical, nor predictable in use. I thought that people would not dare to try the devices without encouragement or a verbal introduction. The third reason was my personal curiosity: I like to observe people when they interact with the things I make. When I observe people using my devices I try to find out if my ideas resonate with unsuspecting users.

My experiment of including the artist into the exhibition itself connects to the idea that Sarah Cook proposes in the essay 'Immateriality and its Discontents' (featured in *New Media in the White Cube and Beyond*, page 26-49). She proposes to shift the curatorial focus to the works' production as much as its distribution and exhibition. [6.2 - Cook, 2008, p45]

During the exhibition I found out that being present did not have the effect I had hoped for. Not only did I feel like an intruder myself, my presence even seemed to scare people away. As visitors did not dare to enter the corner where my exhibition was situated. I thought of several reasons why that might have happened (for specific notes of encounters, see appendix 3.1):

- Visiting a museum seems to be a very private and personal experience. Often visitors would act disturbed when I would invite them into my exhibition-corner.
- A cultural difference between the Netherlands and Finland. Where in the Netherlands visitors easily start speaking to a stranger and interrupt their work, in Finland people seem too polite to disturb a person who looks to be focussed on working.
- I felt a language barrier, which meant that I did not actively engage with people. My knowledge of the Finnish language is not sufficient, so I did not feel comfortable talking to people.
- My presence within the exhibition was unexpected
- Several 'interactive objects' within the Tekniikan Museo's main exhibition were not functioning. The museum staff had attached notes to these objects stating that they were out-of-order. A reason that people did not approach my exhibition-corner could be because the name of my exhibition is 'OUT-OF-ORDER'. Maybe visitors thought that they were not supposed to enter, as my exhibition was under repair?

On the third day of the exhibition I started experimenting with taking more distance from my exhibition. I was observing visitors from a semi-hidden place, while taking notes of the way that visitors were interacting with my devices.



*Out-of-Order exhibition
at the Tekniikan Museo*

This more distant presence turned out to be a success; visitors engaged with the devices as I had hoped when they were not visibly being watched. They figured out how to use the devices through experimentation and by reading the user manuals that I had designed. They took their time while listening and altering sounds. I even overheard conversations where visitors were speculating about technical workings, underlying principles and design methodologies present in my devices. (For specific encounters, see appendix 3.1)

'The best way to understand and appreciate any discipline, whether artistic or not (and music is no exception), is by 'doing' and being part of it.' [6.3 - Jordà, 2004, p333]

I have certain wishes and ideas when it comes to people interacting with my devices. I hope they will speculate and gain an understanding of their workings. Most of all I want the audience to explore (within the boundaries that I give them). Curiosity is a funny mechanism, and as I found out during my exhibition at the Tekniikan Museo, it is also a highly private matter. Even more than I expected.

Further thoughts and speculations

I believe that an audience needs an introduction, which can be in the form of a point of recognition to dive into something new. Imposing unknown concepts to an audience that has no prior connection to a topic will only cause misunderstanding. Instead, if one manages to connect a more general idea to an experimental issue, an unknowing member of the audience is offered an entrance point into a new field. This will enable an artist to get ideas across and helps the audience to gain an understanding.

Conclusions from interactions of the audience at the Tekniikan Museo

The Out-of-Order exhibition at the Tekniikan Museo included five art-devices connected to a sound-system, with their respective hand-drawn schematics, user-manuals and a volume with background information. The Tekniikan Museo was chosen as a venue in order to engage with a curious audience in a non-standard art-environment.

I had included a workspace for myself in the exhibition design, as I expected that my presence would be necessary. However, visitors seemed to be uncomfortable in exploring unfamiliar art-devices while being watched. When I distanced myself more from the exhibition-corner, the audience interacted more freely with the devices; curiosity seems to need privacy.

With the Devices-project I combined unexpected and unfamiliar elements with recognisable everyday interfaces, in order to introduce the audience to underlying electrical principles by tempting them to explore experimental art-devices.

Conclusions

Going back to the exhibition in Lisbon that I mentioned in the introduction: I then thought of these non-functional art-pieces as somehow reassuring, in the sense that my own artworks do not always work flawlessly. A point of frustration that still follows me in my artistic practice. I realise more now that art-pieces are not meant to work perfectly, as they reflect on mechanisms and events from the environment of the maker. It seems that my current environment is filled with half-functioning art-objects that sometimes break and stabilise at other times. I want to build devices that can be used by an audience, that stay relevant for a reasonable time, but are still composed of everyday store-bought components that are subject to technological obsolescence. My art-devices are greatly dependent on the quirks of electrical components, which means that I cannot always influence the way these devices function or keep on functioning over extended stretches of time.

In the first chapter about art and electronics the electronic art-field is defined as a slightly old-fashioned sub-form of new media art, which uses electronics as a medium to explore systems, functions and technological possibilities. Two sub-forms of electronic art were identified; (1) art for which the electronics are inclusive and (2) art for which the electronics are illustrative. These two groups are based on different approaches that artists have towards using electronics:

- The end-user is interested in the result, not the electrical system and generally creates illustrative electronic art.
- The appropriator uses basic consumer electronics that are 'plug-and-play' to create mainly illustrative electronic art.
- The hybrid has limited knowledge of the way electronics work and produces something in between illustrative and inclusive electronic art.
- The inventor is a curious explorer, who has basic knowledge of components and schematics. Creates mainly inclusive electronic art.
- The engineer has a lot of experience in electronics and a thorough knowledge of components. Produces inclusive electronic art.

Electronic art-pieces can break in a technological sense, due to the use of electrical components. When an electrical artwork breaks, it becomes out-of-order. This can either mean that the artwork is physically broken, that it no longer functions as the artist intended or encounters problems through wear and tear or obsolescence. A non-functioning electrical artwork poses a problem, as it is now incomplete and will lose a major part of its meaning. Artists working with electronics spend a large part of their time designing, testing and improving the system that is incorporated in the artwork. This means that it is important that the art-piece is in a functioning state while being exhibited, as the artist did not just spend time creating an aesthetic object or experience, but has spent at least the same amount of time on the electronic content of the artwork.

Repairing an electrical art-piece is not a straightforward process. When an artwork is out-of-order and needs to be repaired, one needs to take into account that the different styles that artists employ for creating electronic art-pieces influence the repair-strategies. There is always the threat that an artwork has become irreparable. When this

happens one can choose between removing the art-piece from the exhibition, faking the desired result and presenting the piece as a work in progress.

The expected lifespan of artworks decreases when they incorporate electronic components. This happens due to the additional factors that functioning electrical artworks impose and the influence of technological obsolescence. In order to prolong the lifespan of an electrical artwork and avoid imminent breakdown, artists and institutions should both take responsibility for properly documenting art-pieces. Where institutions are becoming more aware of their role in the documentation process, artists could take more initiative in providing additional material.

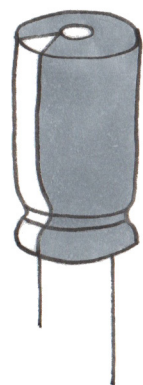
I developed art-devices as a practical exploration of the role of electronics in art and out of curiosity towards how appliances, systems, and electrical objects function. Art-devices can be described as objects that produce light, sound or movement and can be composed with, controlled or influenced by a user. The electronic component is the medium of the art-device and thus produces its meaning. The art-device is closely related to a musical instrument, but where an instrument creates pre-determined tones when played, the output that an art-device produces does not have to follow a logical structure.

The art-devices and their respective hand-drawn schematics, user-manuals and a volume with background information were exhibited in the Tekniikan Museo in Helsinki in February 2017. From this exhibition the following could be concluded:

Curiosity needs privacy, when an audience feels watched they do not tend to engage with the art-devices.

The audience treated the art-devices more carefully than expected. The only out-of-order instances that occurred during the exhibition were due to bad design, insufficient testing and empty batteries.

The Devices-project combined unexpected and unfamiliar elements with recognisable everyday interfaces, in order to introduce the audience to underlying electrical principles, by tempting them to explore experimental art-devices.



References

Per chapter

Chapter 1

- [1.1] Paul, C. (2008). *New Media in the White Cube and Beyond: Curatorial Models for Digital Art*. University of California Press. p3
- [1.2] Paul, C. (2008). *New Media in the White Cube and Beyond: Curatorial Models for Digital Art*. University of California Press. p1
- [1.3] Wilson, S. (2002). *Information Arts: Intersections of Art, Science and Technology*. MIT Press: Cambridge, Massachusetts. p6
- [1.4] Paul, C. (2008). *New Media in the White Cube and Beyond: Curatorial Models for Digital Art*. University of California Press. p3
- [1.5] Real, W. A. (2001). Toward Guidelines for Practice in the Preservation and Documentation of Technology-Based Installation Art. *JAIC* 40 (2001):125-136.
- [1.6] Neves, C.M.P, and others (2010). *Collaborations in Conserving Time-Based Art*. Smithsonian institution: Office of Policy and Analysis, Washington DC 20013. Retrieved January 2016 from https://www.si.edu/Content/consortia/Time-Based-Art_Report.pdf. p10
- [1.7] Wilson, S. (2002). *Information Arts: Intersections of Art, Science and Technology*. MIT Press: Cambridge, Massachusetts. p388
- [1.8] Wilson, S. (2002). *Information Arts: Intersections of Art, Science and Technology*. MIT Press: Cambridge, Massachusetts. p6
- [1.9] Arduino. (n.d.). Retrieved April 2017 from <https://www.arduino.cc/>
- [1.10] Definition of techno-fetishism in English. (n.d.). Retrieved October 2016 from <https://en.oxforddictionaries.com/definition/us/techno-fetishism>

Chapter 2

- [2.1] Son, van M. (2017) *Devices - What, How and why: a collection of ideas and statements*. In *Titanik 2017*, edited by A.J. Manninen, A. Turkko and E. Suvanto. Pp 15-18. Finepress, Turku.
- [2.2] McLellan, T. (2013). *Things Come Apart*. Thames & Hudson: New York, USA. p10
- [2.3] Cook, S. (2008) *Immateriality and its Discontents*. In *New Media in the White Cube and Beyond*, edited by Christiane Paul, pp 26-49. Berkeley and Los Angeles, California: University of California Press. p45
- [2.4] Wilson, S. (2002). *Information Arts: Intersections of Art, Science and Technology*. MIT Press: Cambridge, Massachusetts. p399
- [2.5] Real, W. A. (2001). Toward Guidelines for Practice in the Preservation and Documentation of Technology-Based Installation Art. *JAIC* 40 (2001):125-136.
- [2.6] Real, W. A. (2001). Toward Guidelines for Practice in the Preservation and Documentation of Technology-Based Installation Art. *JAIC* 40 (2001):125-136.

Chapter 3

- [3.1] Son, van M. (2017) Devices - What, How and why: a collection of ideas and statements. In *Titanik 2017*, edited by A.J. Manninen, A. Turkko and E. Suvanto. Pp 15-18. Finepress, Turku.
- [3.2] Real, W. A. (2001). Toward Guidelines for Practice in the Preservation and Documentation of Technology-Based Installation Art. *JAIC* 40 (2001):125-136.
- [3.3] Neves, C.M.P, and others (2010). Collaborations in Conserving Time-Based Art. Smithsonian institution: Office of Policy and Analysis, Washington DC 20013. Retrieved January 2016 from https://www.si.edu/Content/consortia/Time-Based-Art_Report.pdf P9
- [3.4] Wilson, S. (2002). *Information Arts: Intersections of Art, Science and Technology*. MIT Press: Cambridge, Massachusetts. p30-31
- [3.5] Paul, C. (2008). *New Media in the White Cube and Beyond: Curatorial Models for Digital Art*. University of California Press. p2
- [3.6] Paul, C. (2008). *New Media in the White Cube and Beyond: Curatorial Models for Digital Art*. University of California Press. p1
- [3.7] Real, W. A. (2001). Toward Guidelines for Practice in the Preservation and Documentation of Technology-Based Installation Art. *JAIC* 40 (2001):125-136.
- [3.8] Neves, C.M.P, and others (2010). Collaborations in Conserving Time-Based Art. Smithsonian institution: Office of Policy and Analysis, Washington DC 20013. Retrieved January 2016 from https://www.si.edu/Content/consortia/Time-Based-Art_Report.pdf p6
- [3.9] Real, W. A. (2001). Toward Guidelines for Practice in the Preservation and Documentation of Technology-Based Installation Art. *JAIC* 40 (2001):125-136.
- [3.10] Neves, C.M.P, and others (2010). Collaborations in Conserving Time-Based Art. Smithsonian institution: Office of Policy and Analysis, Washington DC 20013. Retrieved January 2016 from https://www.si.edu/Content/consortia/Time-Based-Art_Report.pdf p6
- [3.11] Real, W. A. (2001). Toward Guidelines for Practice in the Preservation and Documentation of Technology-Based Installation Art. *JAIC* 40 (2001):125-136.
- [3.12] Real, W. A. (2001). Toward Guidelines for Practice in the Preservation and Documentation of Technology-Based Installation Art. *JAIC* 40 (2001):125-136.
- [3.13] Neves, C.M.P, and others (2010). Collaborations in Conserving Time-Based Art. Smithsonian institution: Office of Policy and Analysis, Washington DC 20013. Retrieved January 2016 from https://www.si.edu/Content/consortia/Time-Based-Art_Report.pdf p6

Chapter 4

- [4.1] Cage, J. (1937). *The Future of Music: Credo*. Retrieved July 2016 from http://ixi-software.net/workshops/pdfs/Instruments_are_Systems.pdf
- [4.2] Son, van M. (2017) Devices - What, How and why: a collection of ideas and statements. In *Titanik 2017*, edited by A.J. Manninen, A. Turkko and E. Suvanto. Pp 15-18. Finepress, Turku.
- [4.3] Ostashevsky, E. (2015). *Italian Futurism and the Cult of the Machine*. Retrieved January 2016 from <http://www.nyu.edu/projects/mediamosaic/thetitanic/pdf/ostashevsky-eugene.pdf> p5
- [4.4] Chadabe, J. (1996). *The History of Electronic Music as a Reflection of Structural Paradigms*. Leonardo Music

Journal, Volume 6, pp 41-44. MIT Press: Cambridge, Massachusetts p41

[4.5] Definition of instrument. (n.d.) Retrieved October 2016 from <http://www.merriam-webster.com/dictionary/instrument>

[4.6] Jordà, S. (2004). Instruments and Players: Some thoughts on Digital Lutherie. *Journal of New Music Research*, 33:3, 321-341. p321

[4.7] Bongers, B. (2007). Electronic Musical Instruments: Experiences of a New Luthier. *Leonardo Music Journal*, Volume 17, 2007, pp 9-16, Published by MIT Press. p9

[4.8] Son, van M. (2017) Devices - What, How and why: a collection of ideas and statements. In *Titanik 2017*, edited by A.J. Manninen, A. Turkko and E. Suvanto. Pp 15-18. Finepress, Turku.

[4.9] Jordà, S. (2004). Instruments and Players: Some thoughts on Digital Lutherie. *Journal of New Music Research*, 33:3, 321-341. p335

[4.10] Jordà, S. (2004). Instruments and Players: Some thoughts on Digital Lutherie. *Journal of New Music Research*, 33:3, 321-341. p331

[4.11] Jordà, S. (2004). Instruments and Players: Some thoughts on Digital Lutherie. *Journal of New Music Research*, 33:3, 321-341. p326

[4.12] Jordà, S. (2004). Instruments and Players: Some thoughts on Digital Lutherie. *Journal of New Music Research*, 33:3, 321-341. p324

[4.13] Chadabe, J. (1996). The History of Electronic Music as a Reflection of Structural Paradigms. *Leonardo Music Journal*, Volume 6, pp 41-44. MIT Press: Cambridge, Massachusetts. p43

[4.14] Chadabe, J. (1996). The History of Electronic Music as a Reflection of Structural Paradigms. *Leonardo Music Journal*, Volume 6, pp 41-44. MIT Press: Cambridge, Massachusetts. p44

Chapter 5

[5.1] Son, van M. (2017) Devices - What, How and why: a collection of ideas and statements. In *Titanik 2017*, edited by A.J. Manninen, A. Turkko and E. Suvanto. Pp 15-18. Finepress, Turku.

Chapter 6

[6.1] Info | Tekniikan Museo. (n.d.). Retrieved April 9, 2017, from <http://tekniikanmuseo.fi/in-english/>

[6.2] Cook, S. (2008) Immateriality and its Discontents. In *New Media in the White Cube and Beyond*, edited by Christiane Paul, pp 26-49. Berkeley and Los Angeles, California: University of California Press. p45

[6.3] Jordà, S. (2004). Instruments and Players: Some thoughts on Digital Lutherie. *Journal of New Music Research*, 33:3, 321-341. p333

Alphabetical

Arduino. (n.d.). Retrieved April 2017 from <https://www.arduino.cc/>

Bennett, J. (2014). Encounters with an Art-Thing. Retrieved November 2015 from http://salvageartinstitute.org/janebennett_encounterswiththesartthing.pdf

Bongers, B. (2007). Electronic Musical Instruments: Experiences of a New Luthier. *Leonardo Music Journal*, Volume 17, 2007, pp 9-16, Published by MIT Press.

Cage, J. (1937). The Future of Music: Credo. Retrieved July 2016 from http://ixi-software.net/workshops/pdfs/Instruments_are_Systems.pdf

Cook, S. (2008) Immateriality and its Discontents. In *New Media in the White Cube and Beyond*, edited by Christiane Paul, pp 26-49. Berkeley and Los Angeles, California: University of California Press.

Chadabe, J. (1996). The History of Electronic Music as a Reflection of Structural Paradigms. *Leonardo Music Journal*, Volume 6, pp 41-44. MIT Press: Cambridge, Massachusetts

Collins, N. (2009). *Handmade Electronic Music: The Art of Hardware Hacking* (2nd edition). Routledge: New York, USA.

Definition of instrument. (n.d.) Retrieved October 2016 from <http://www.merriam-webster.com/dictionary/instrument>

Definition of techno-fetishism in English. (n.d.). Retrieved October 2016 from <https://en.oxforddictionaries.com/definition/us/techno-fetishism>

Dorin, A. (2013). Chance and Complexity: Stochastic and Generative Processes in Art and Creativity. *Proceedings of VRIC'13*. Loriet (ed.) Laval, France. ACM Press, 8pp.

Hopkin, B. (1996). *Musical Instrument Design*. See Sharp Press: Tucson, Arizona.

Info | Tekniikan Museo. (n.d.). Retrieved April 9, 2017, from <http://tekniikanmuseo.fi/in-english/>

Jordà, S. (2004). Instruments and Players: Some thoughts on Digital Lutherie. *Journal of New Music Research*, 33:3, 321-341.

Kemp, J. (1964). The Work of Art and the Artist's Intentions. *British Journal of Aesthetics*, no.4, pp 146-154. doi: <https://doi.org/10.1093/bjaesthetics/4.2.146>

Lodder, C. (2007). Naum Gabo and the Quanderies of the Replica. Tate Papers, no.8. Retrieved November 2015 from <http://www.tate.org.uk/research/publications/tate-papers/08/naum-gabo-and-the-quanderies-of-the-replica>. ISSN 1753-9854

McLellan, T. (2013). Things Come Apart. Thames & Hudson: New York, USA.

Neves, C.M.P, and others (2010). Collaborations in Conserving Time-Based Art. Smithsonian institution: Office of Policy and Analysis, Washington DC 20013. Retrieved January 2016 from https://www.si.edu/Content/consortia/Time-Based-Art_Report.pdf

Ostashevsky, E. (2015). Italian Futurism and the Cult of the Machine. Retrieved January 2016 from <http://www.nyu.edu/projects/mediamosaic/thetitanic/pdf/ostashevsky-eugene.pdf>

Paul, C. (2008). New Media in the White Cube and Beyond: Curatorial Models for Digital Art. University of California Press.

Real, W. A. (2001). Toward Guidelines for Practice in the Preservation and Documentation of Technology-Based Installation Art. JAIC 40 (2001):125-136.

Shinn, D. (1990). Robert Smithson's Partially Buried Woodshed. KSU School of Art, exhibition catalog. Retrieved November 2015 from <https://www.robertsmithson.com/essays/pbw.pdf>

Son, van M. (2017) Devices - What, How and why: a collection of ideas and statements. In Titanik 2017, edited by A.J. Manninen, A. Turkko and E. Suvanto. Pp 15-18. Finepress, Turku.

Wilson, S. (2002). Information Arts: Intersections of Art, Science and Technology. MIT Press: Cambridge, Massachusetts.

Zielinski, S. (2008). Deep Time of the Media. The MIT Press: Cambridge Massachusetts.

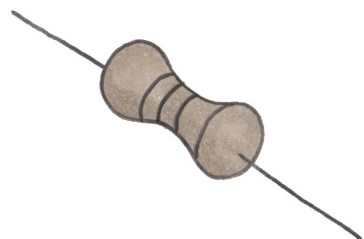


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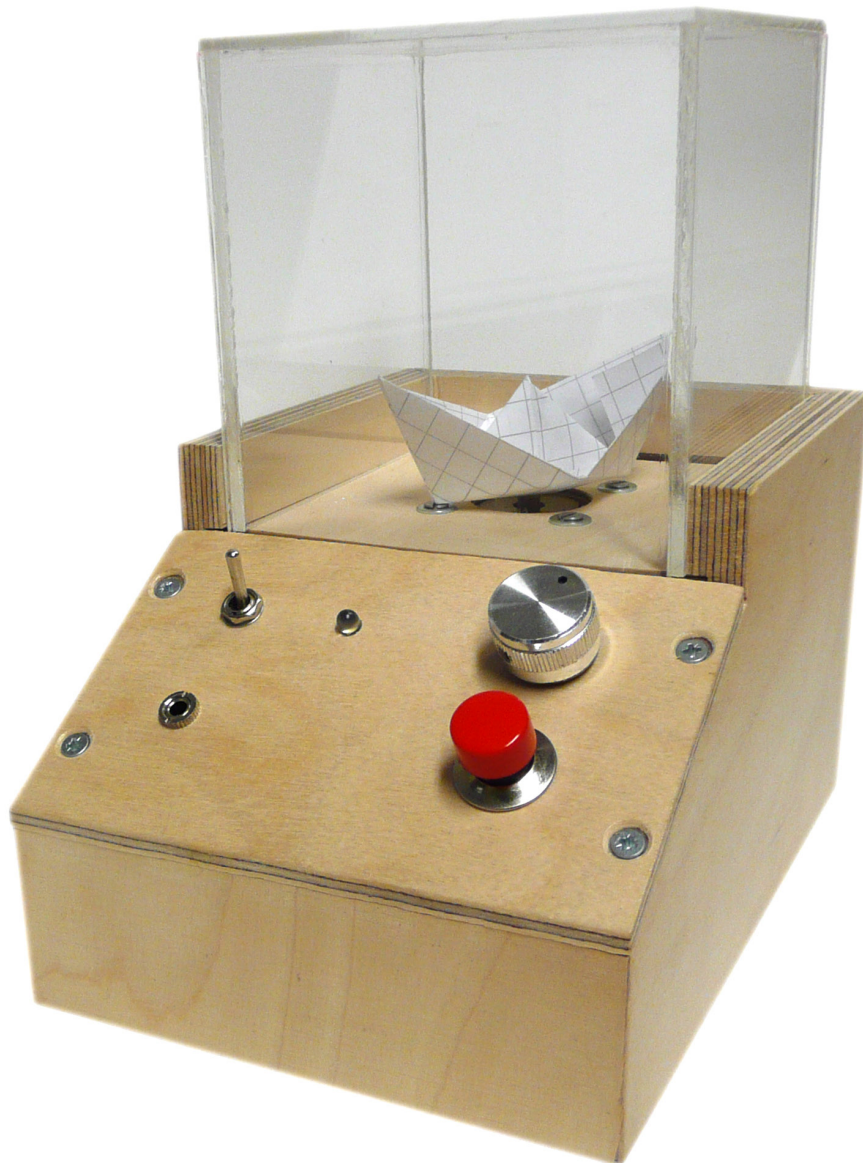
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1.1 RESO

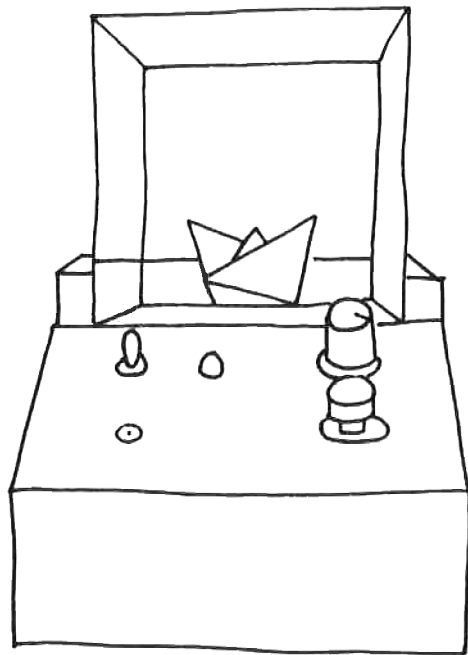
- image
- description
- schematics
- user manual

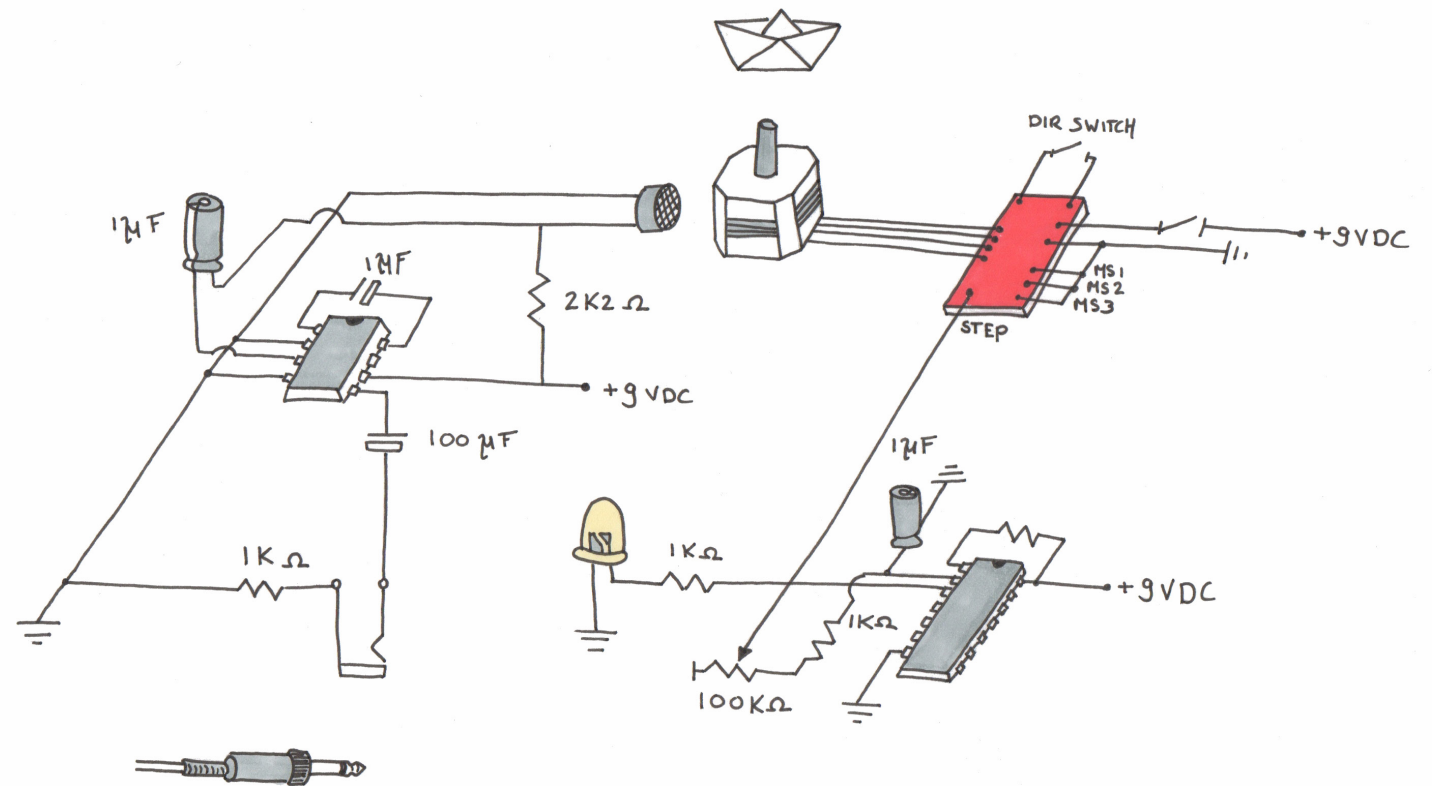


RESO

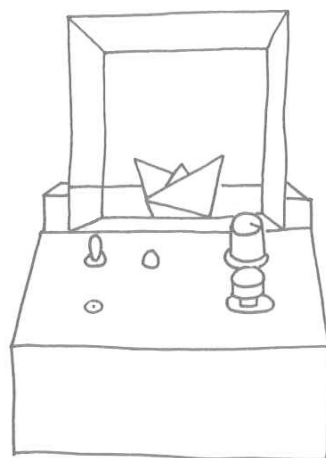
Experimental instrument that uses the resonating frequencies of a stepper motor as a tone generator. The motor, controlled by an oscillator, creates different frequencies for different speeds. These particular stepper-motors produce a rich tonal spectrum that reminds people of obsolete plotters and cheap printers. Based on the idea of appropriating (annoying) noises made by electrical appliances as compositional material.

The buttons on the front panel control motor speed / frequency, rotating direction and an ON/OFF switch. Next to this the device has a built in amplification system, which can be connected to an external sound system.





USER MANUAL



.....

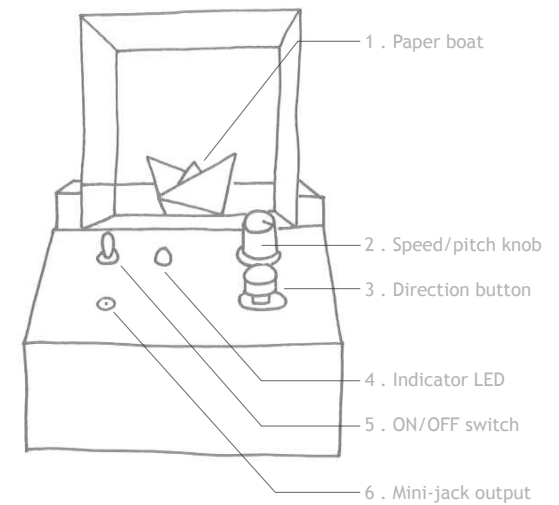
RESO: Experimental instrument that uses the noise of a stepper motor as sound-source. Based on the idea of appropriating (annoying) noises made by electrical appliances as compositional material.

.....

INSTRUCTIONS

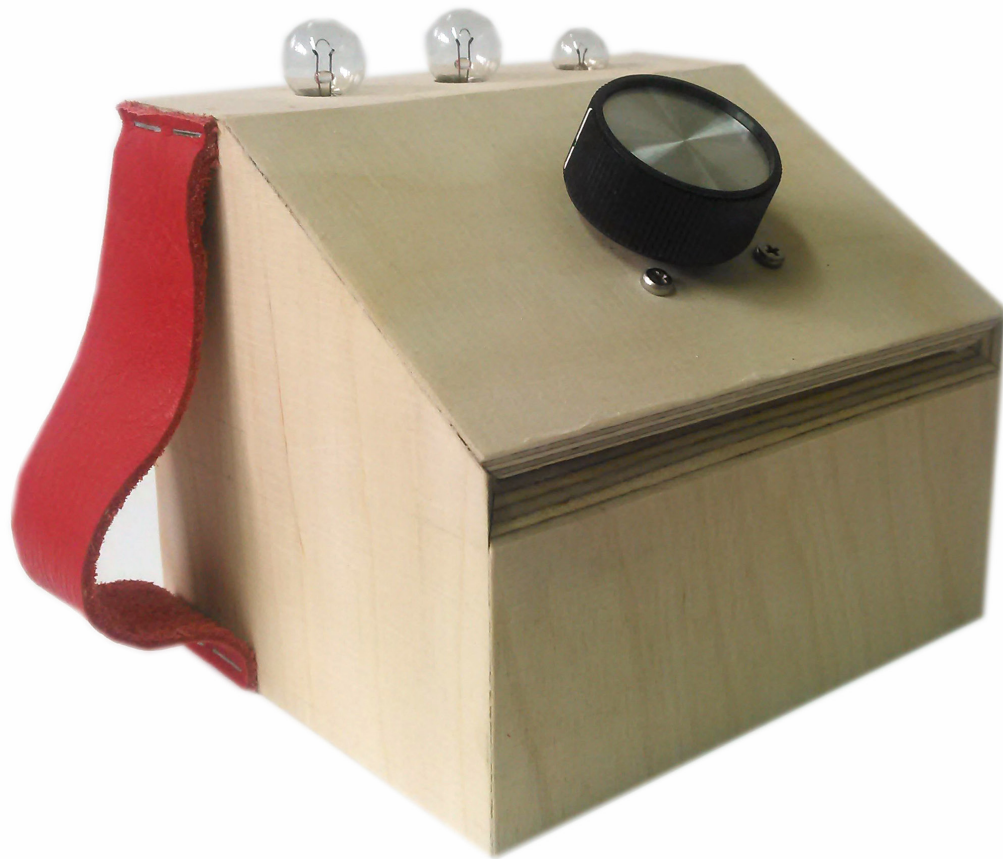
Place RESO on a table. Activate the motor with the ON/OFF switch (5). Twist the knob (2) to change the pitch and speed. To change direction press the red button (3). The sound can be amplified by attaching speakers/headphones from the mini-jack output (6). The paper boat (1) can be replaced.

.....



1.2 LAMP

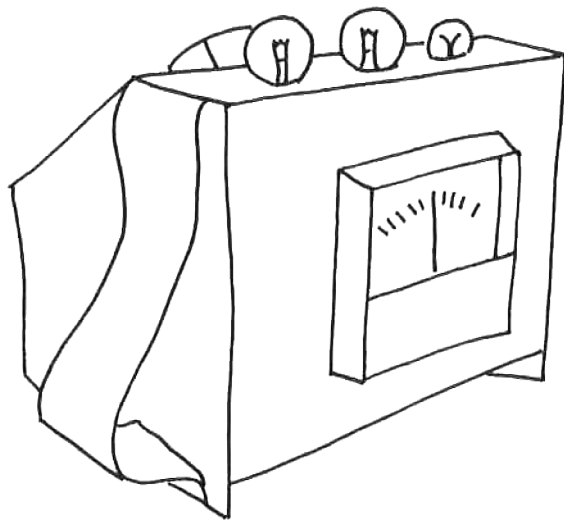
- image
- description
- schematics



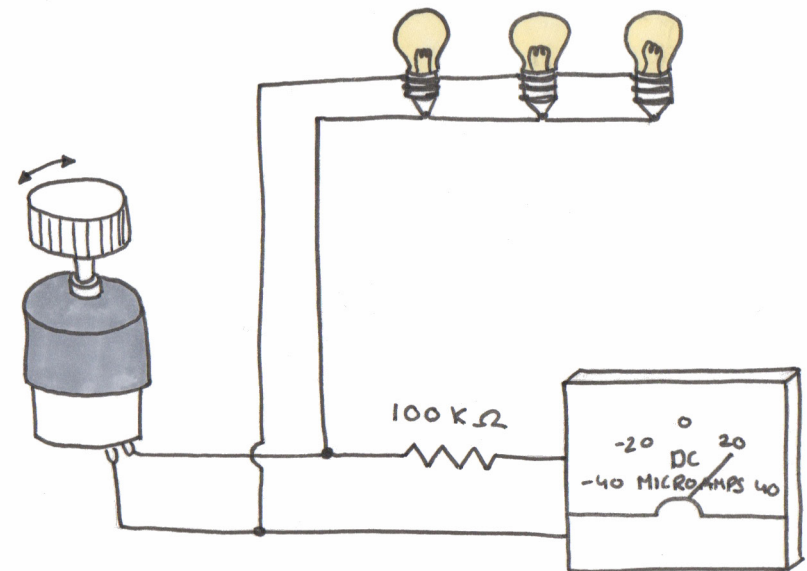
LAMP

Portable Arduous Light Device. This device enables the user to generate light by turning a knob, which takes more effort than would be desirable.

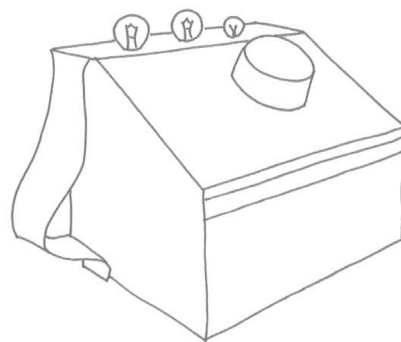
In a fairly simple setup, a geared dc-motor is used as a dynamo. This dynamo generates power for three small incandescent lightbulbs. Simultaneously the amount of power generated by the user is displayed on the current meter at the back of the device.



1 : 30 , 12 VDC
GEARED MOTOR



USER MANUAL



.....

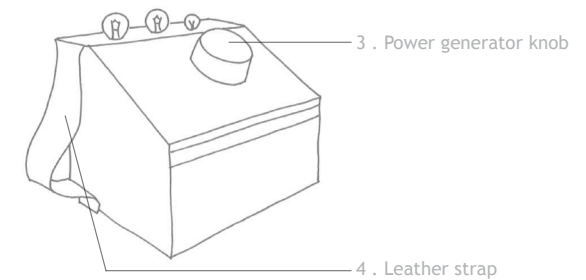
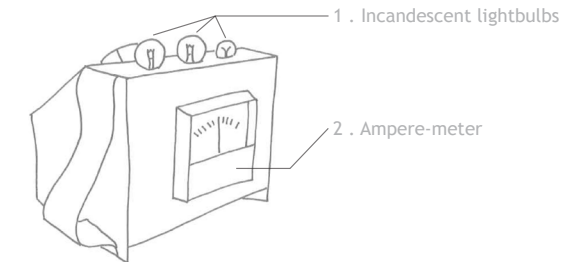
LAMP: Portable Arduous Light Device. A device that enables the user to generate light by turning a knob, which takes more effort than would be desirable.

.....

INSTRUCTIONS

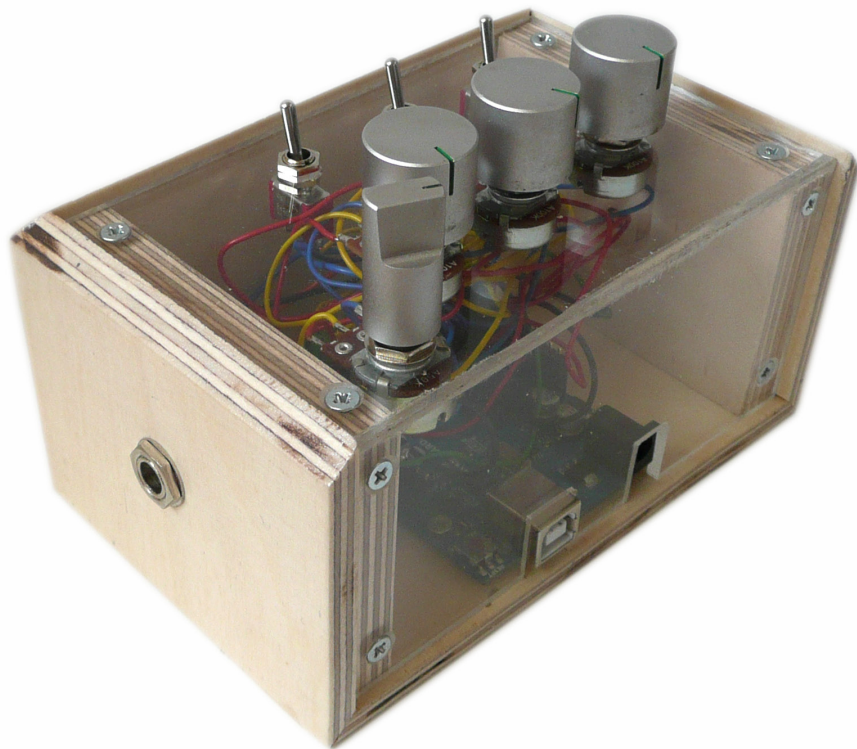
Hold LAMP with your left hand under the leather strap (4). Twist the knob (3) clockwise and/or anti-clockwise to generate the power necessary to activate the lights. The amount of generated power can be checked from the ampere-meter (2). Be careful not to break the incandescent lightbulbs (1), as replacement parts are available for a limited time only.

.....



1.3 CardBox

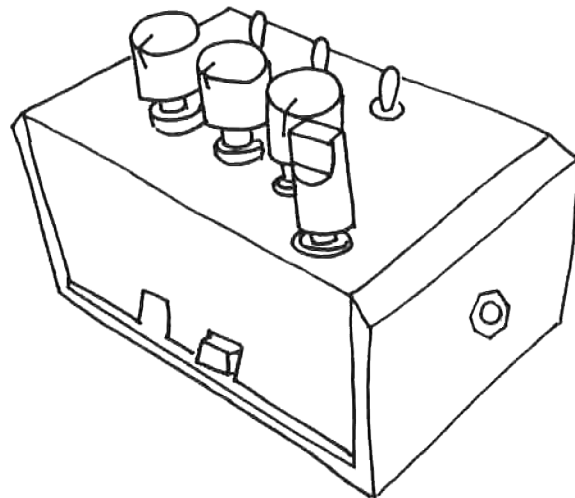
- image
- description
- schematics
- prototype
- user manual
- code

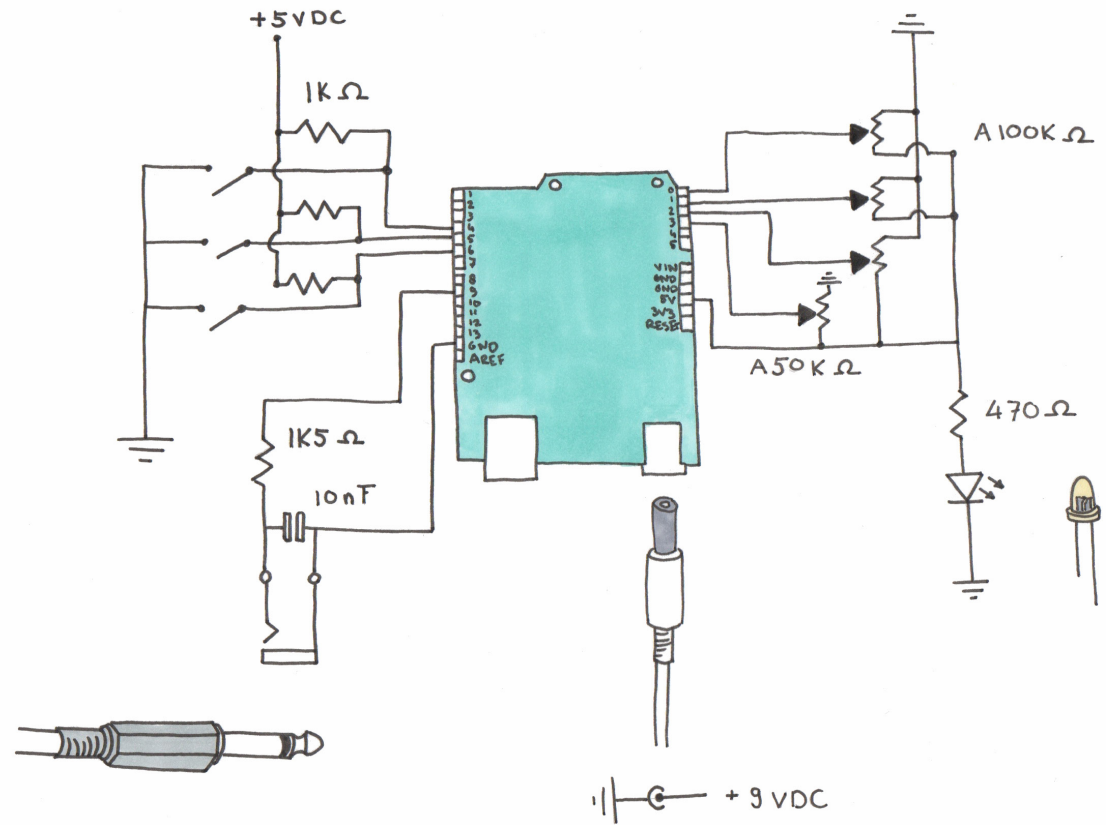


CardBox

Potentiometer-controlled sound instrument using Arduino as a digital oscillator. The programmed micro-controller creates different frequencies and sound patterns. Its current programming is based on the Mozzi-library and uses additive synthesis with a shimmer effect.

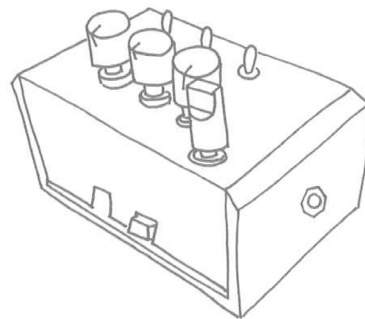
The potentiometers control shimmer, frequency, harmonics and volume. With the toggle-switches different wave-forms can be selected. The different options are: sine-wave, square-wave and triangle-wave. Apart from the steady tones that CardBox mainly produces, certain settings provide pulsed patterns. The programming includes a small random delay, which results in slightly unpredictable timing while playing.







USER MANUAL



www.marloesvanson.nl

CardBox

.....

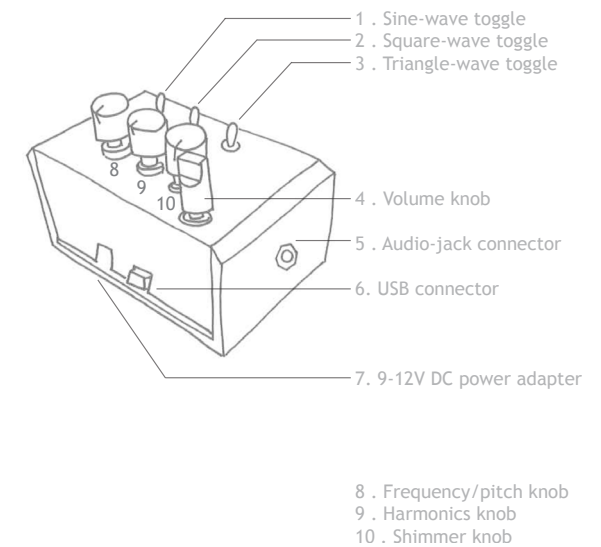
CardBox: Potentiometer-controlled sound instrument using Arduino as programmable digital oscillator. The current programming makes use of additive synthesis with a shimmer effect.

.....

INSTRUCTIONS

Place CardBox on a table. Connect the 9-12V DC power adapter (7) and speakers/headphones (5). Activate a digital oscillator with the toggle switches (1-3). Note: the oscillators cannot work simultaneously. Volume, shimmer, frequency and harmonics can be altered with the corresponding knobs (4,8-10). For advanced use: the programming can be changed by connecting a USB-cable (6), Arduino-software required.

.....



Arduino code for CardBox

```

/* Using Mozzi sonification library.

Circuit: Audio output on digital pin 9 on a Uno
check the README or http://sensorium.github.com/Mozzi/

Based on code by Tim Barrass 2012, CC by-nc-sa.
*/

#include <Oscil.h>
#include <EventDelay.h>
#include <mozzi_rand.h>
#include <tables/cos2048_int8.h>
#include <tables/square_no_alias_2048_int8.h>
#include <tables/saw2048_int8.h>

// use #define for CONTROL_RATE, not a constant
#define CONTROL_RATE 64 // powers of 2 please

// use: Oscil <table_size, update_rate> oscilName (wavetable), look in .h file of table #included above
Oscil <COS2048_NUM_CELLS, AUDIO_RATE> aGain(COS2048_DATA); // to fade audio signal in and out before wave-
shaping

// option 1
Oscil <COS2048_NUM_CELLS, AUDIO_RATE> aCos1(COS2048_DATA); // sine wave sound source
Oscil <COS2048_NUM_CELLS, AUDIO_RATE> aCos2(COS2048_DATA); // sine wave sound source

// option 2
Oscil <SQUARE_NO_ALIAS_2048_NUM_CELLS, AUDIO_RATE> aSquare1(SQUARE_NO_ALIAS_2048_DATA); // sine wave sound
source
Oscil <SQUARE_NO_ALIAS_2048_NUM_CELLS, AUDIO_RATE> aSquare2(SQUARE_NO_ALIAS_2048_DATA); // sine wave sound
source

// option 3
Oscil <SAW2048_NUM_CELLS, AUDIO_RATE> aSaw1(SAW2048_DATA); // sine wave sound source
Oscil <SAW2048_NUM_CELLS, AUDIO_RATE> aSaw2(SAW2048_DATA); // sine wave sound source

// for scheduling note changes
EventDelay kChangeNoteDelay;

const char INPUT_PIN_0 = 0; //set the input for the knob to analog pin 0
// to convey the volume level from updateControl() to updateAudio()
byte volume;

const char INPUT_PIN_1 = 1; //set the input for the knob to analog pin 1
byte sensor_value_1;

```

```

const char INPUT_PIN_2 = 2; //set the input for the knob to analog pin 2
byte sensor_value_2;

const char INPUT_PIN_3 = 3; //set the input for the knob to analog pin 3
byte sensor_value_3;

int switch_4 = 4;
int switch_5 = 5;
int switch_6 = 6;

boolean output_4 = false;
boolean output_5 = false;
boolean output_6 = false;

int clipped = 0;

Q16n16 freq1;
Q16n16 freq2;

//-----

void setup() {
  //Serial.begin(115200);
  startMozzi(CONTROL_RATE); // set a control rate of 64 (powers of 2 please)
  aGain.setFreq(0.2f); // use a float for low frequencies, in setup it doesn't need to be fast
  startMozzi();

  pinMode(switch_4, INPUT);
  pinMode(switch_5, INPUT);
  pinMode(switch_6, INPUT);
}

//-----

void updateControl() {
  // VOLUME CONTROL
  // read the variable resistor for volume
  int temp_0 = mozziaAnalogRead(INPUT_PIN_0); // value is 0-1023
  volume = map(temp_0, 0, 1023, 0, 255);

  int temp_1 = mozziaAnalogRead(INPUT_PIN_1); // value is 0-1023
  int temp_2 = mozziaAnalogRead(INPUT_PIN_2); // value is 0-1023
  int temp_3 = mozziaAnalogRead(INPUT_PIN_3); // value is 0-1023
  // map sensorvalues for accurate range
  sensor_value_1 = map(temp_1, 0, 1023, 0, 255);
  sensor_value_2 = map(temp_2, 0, 1023, 0, 24);
  sensor_value_3 = map(temp_3, 0, 1023, 0, 255);

  kChangeNoteDelay.set(rand(50,600)); // note duration ms, within resolution of CONTROL_RATE

```

```

int switch_state_4 = digitalRead(switch_4);
int switch_state_5 = digitalRead(switch_5);
int switch_state_6 = digitalRead(switch_6);

if(kChangeNoteDelay.ready()){
    // change proportional frequency of second tone
    freq1 = Q8n0_to_Q16n16(sensor_value_1); // audio frequency as Q16n16 fractional number
    byte harmonic = sensor_value_1 + sensor_value_2;
    byte shimmer = sensor_value_3;
    Q16n16 harmonic_step = freq1/12;
    Q16n16 freq2difference = harmonic*harmonic_step;
    freq2difference += (harmonic_step*shimmer)>>11;
    freq2 = freq1-freq2difference;
    kChangeNoteDelay.start();
}

// only switch 1 activated
if(switch_state_4 == HIGH && switch_state_5 == LOW && switch_state_6 == LOW) {
    aCos1.setFreq_Q16n16(freq1); // set the frequency with a Q16n16 fractional number
    aCos2.setFreq_Q16n16(freq2); // set the frequency with a Q16n16 fractional number
    output_4 = true;
    output_5 = false;
    output_6 = false;
}

// only switch 2 activated
if(switch_state_4 == LOW && switch_state_5 == HIGH && switch_state_6 == LOW) {
    aSquare1.setFreq_Q16n16(freq1); // set the frequency with a Q16n16 fractional number
    aSquare2.setFreq_Q16n16(freq2); // set the frequency with a Q16n16 fractional number
    output_4 = false;
    output_5 = true;
    output_6 = false;
}

// only switch 3 activated
if(switch_state_4 == LOW && switch_state_5 == LOW && switch_state_6 == HIGH) {
    aSaw1.setFreq_Q16n16(freq1); // set the frequency with a Q16n16 fractional number
    aSaw2.setFreq_Q16n16(freq2); // set the frequency with a Q16n16 fractional number
    output_4 = false;
    output_5 = false;
    output_6 = true;
}

// all switches LOW
if(switch_state_4 == LOW && switch_state_5 == LOW && switch_state_6 == LOW) {
    aCos1.setFreq_Q16n16(0); // set the frequency with a Q16n16 fractional number
    aCos2.setFreq_Q16n16(0);
    aSquare1.setFreq_Q16n16(0);
    aSquare2.setFreq_Q16n16(0);
    aSaw1.setFreq_Q16n16(0); // set the frequency with a Q16n16 fractional number
}

```

```

        aSaw2.setFreq_Q16n16(0);
        output_4 = false;
        output_5 = false;
        output_6 = false;
    }
}

//-----

int updateAudio() {
    if(output_4 == true && output_5 == false && output_6 == false) {
        int asig = (int)((((uint32_t)aCos1.next()+ aCos2.next())*(200u+aGain.next()))>>3);
        clipped = constrain(asig,-244,243);
    }
    if(output_4 == false && output_5 == true && output_6 == false) {
        int asig = (int)((((uint32_t)aSquare1.next()+ aSquare2.next())*(200u+aGain.next()))>>3);
        clipped = constrain(asig,-244,243);
    }
    if(output_4 == false && output_5 == false && output_6 == true) {
        int asig = (int)((((uint32_t)aSaw1.next()+ aSaw2.next())*(200u+aGain.next()))>>3);
        clipped = constrain(asig,-244,243);
    }
    return (clipped * volume)>>8; // shift back into range after multiplying by 8 bit value
}

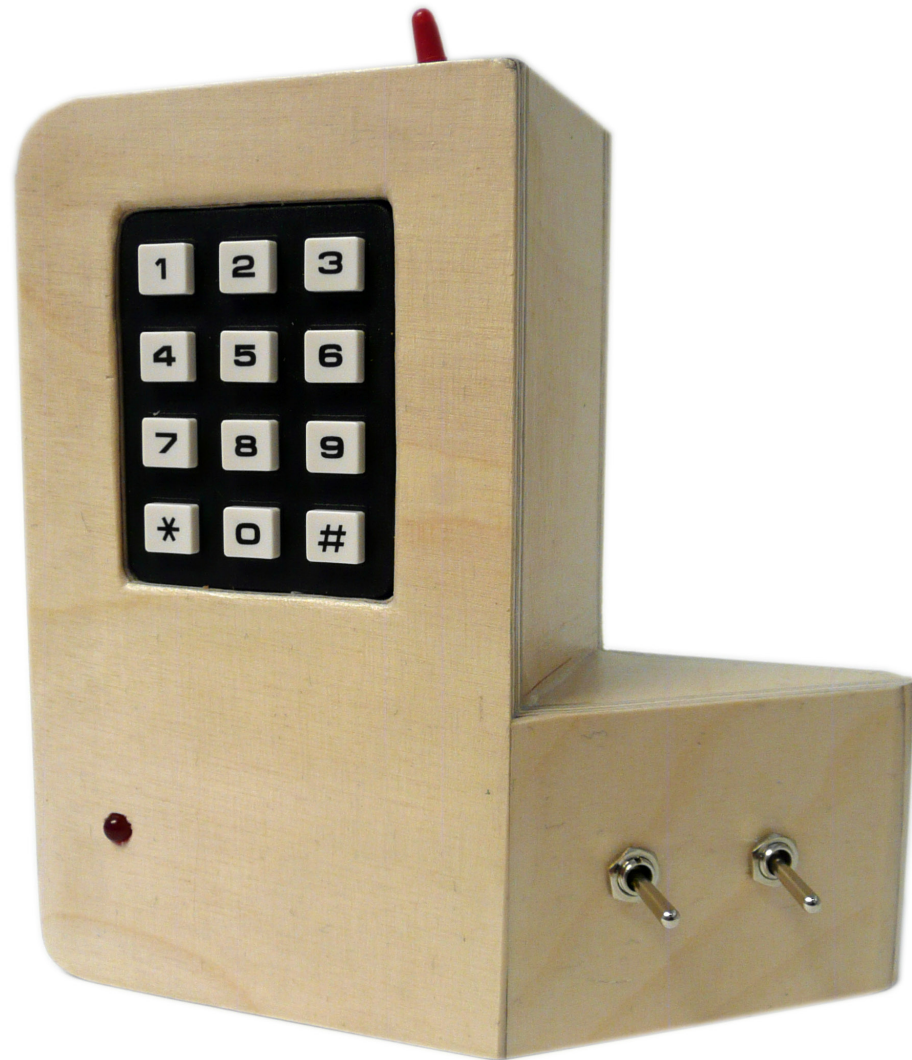
//-----

void loop() {
    audioHook(); // required here
}

```


1.4 Phynth

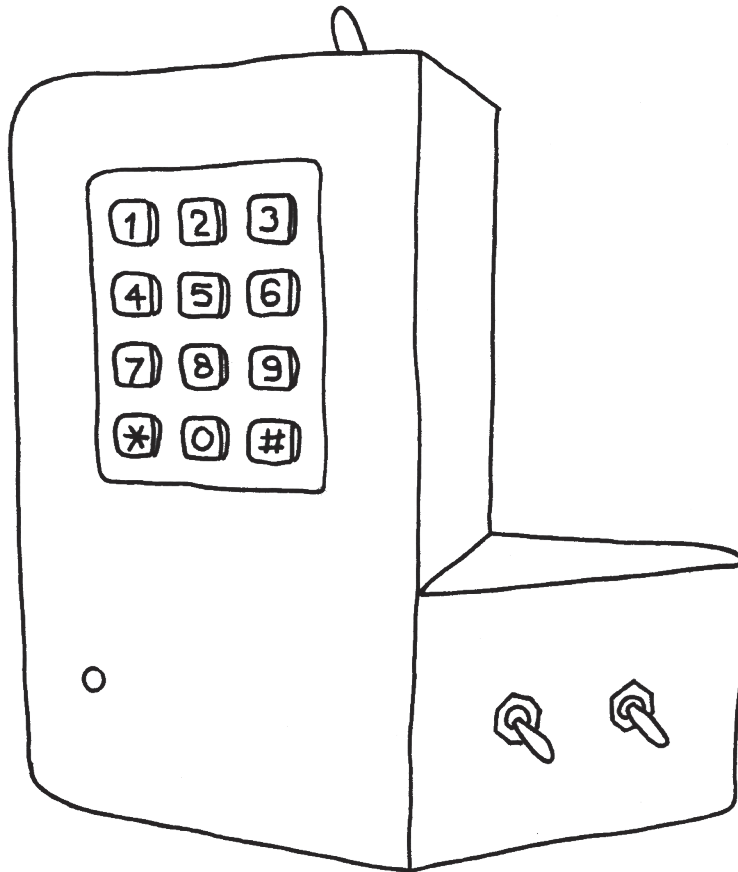
- image
- description
- schematics
- prototype
- user manual
- code

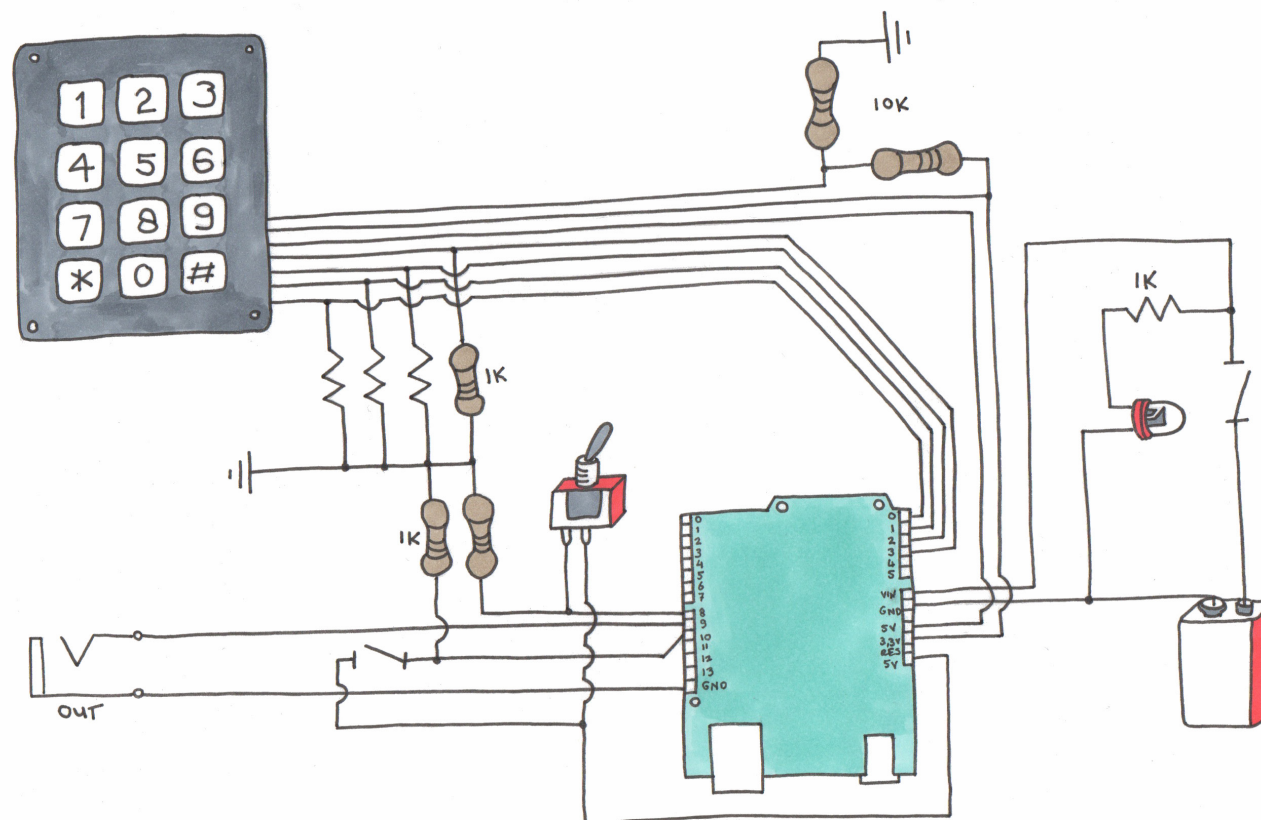


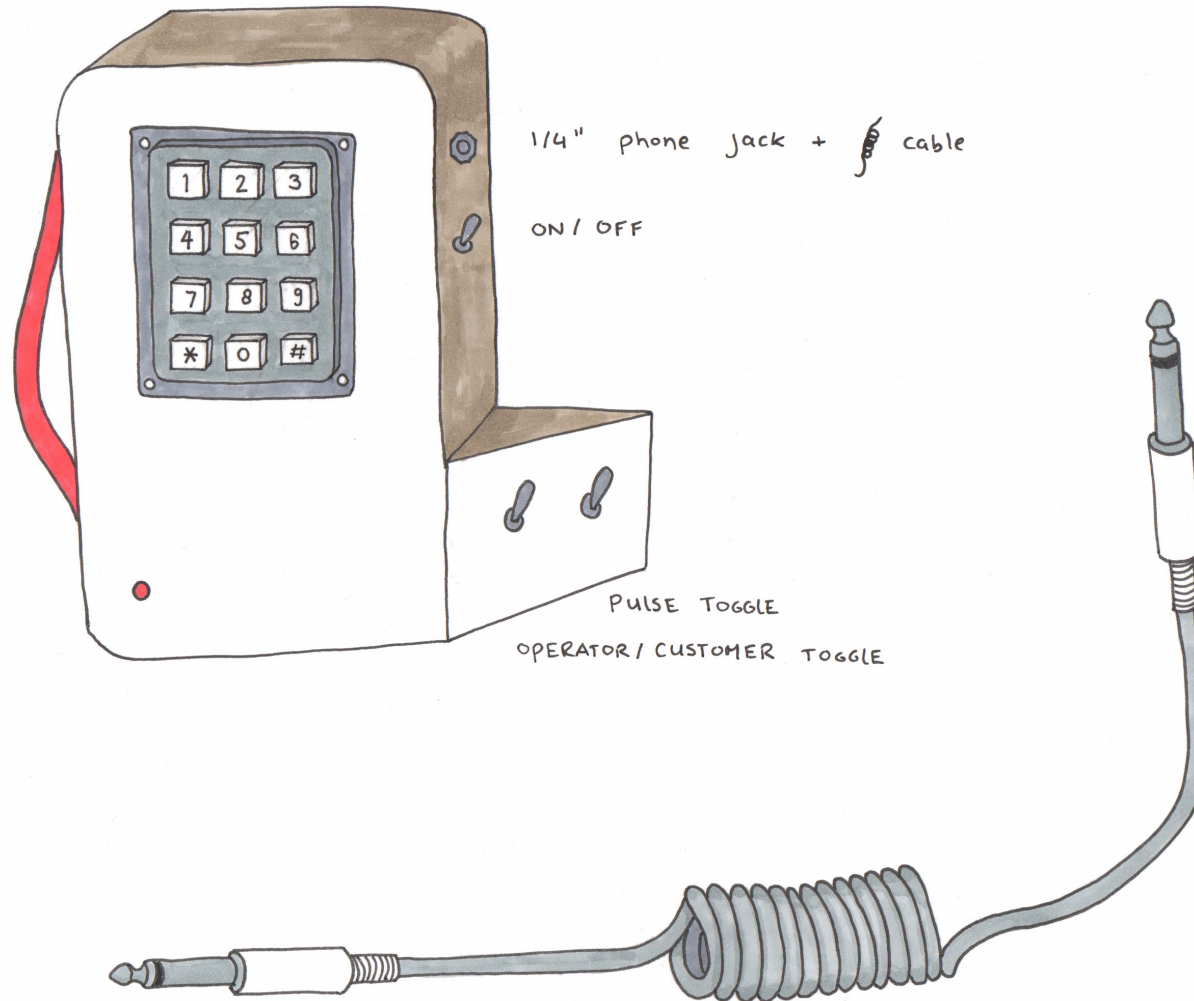
Phynth

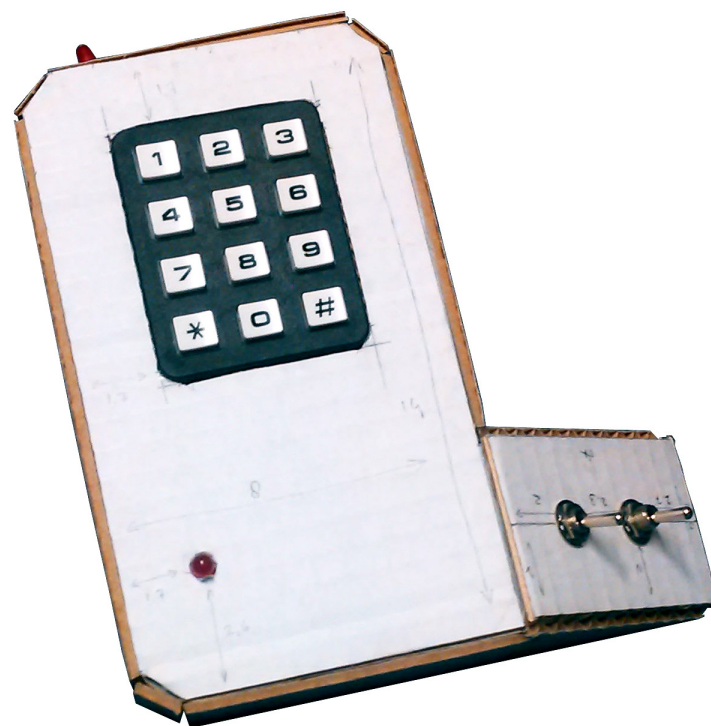
Short for PHone sYNTH. When analog telephony was still the standard, phone numbers were communicated from consumers to operators via combinations of sine waves or pulse sequences. Phone hackers developed an illegal device, the so called 'blue box', that enabled them to call for free. These 'blue boxes' consisted of a keypad connected to frequency generators and a speaker, which essentially makes it a very limited synthesiser. Nowadays telephony has been digitised and blue boxes became obsolete. The dial tones that are still present in mobile phones are only a reminder of an old-fashioned system.

Phynth is an extended digital version of a blue box, purely meant as a sound generator.

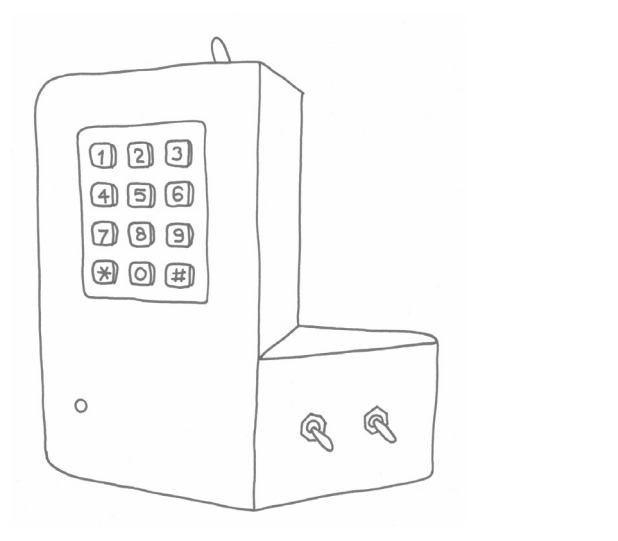








USER MANUAL



.....

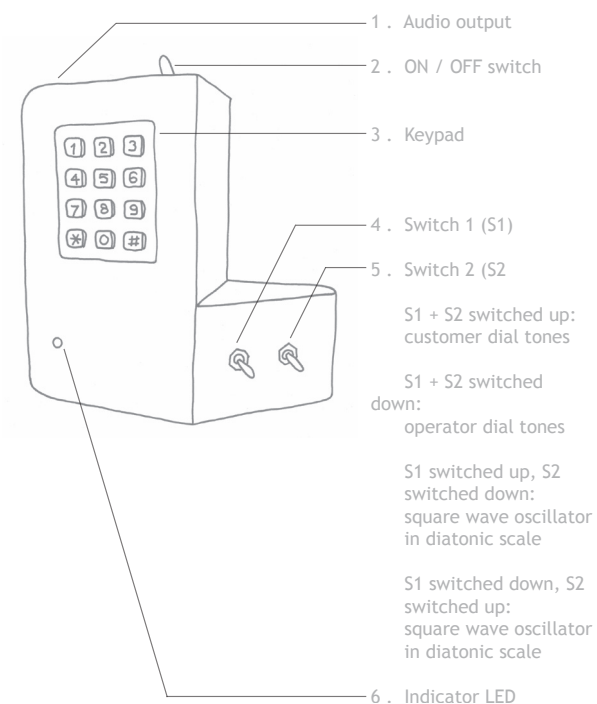
Phynth: When analog telephony was still the standard, phone numbers were communicated from consumers to operators via combinations of sine waves or pulse sequences. Nowadays telephony has been digitised and dial tones have become obsolete. The dial tones that are still present in mobile phones are only a reminder of an old-fashioned system. Phynth is an extended digital version of a dial tone generator, purely meant as sound device.

.....

INSTRUCTIONS

Connect a speaker to the audio output (1). Switch Phynth on (2). Access different sound-presets with the switches (4, 5). Press the keypad-buttons to play.

.....



Arduino code for Phynth

```

/* alternative keypad code

connection diagram keypad (top view, left to right:
1: 1+4      2: 2+4      3: 3+4
4: 1+5      5: 2+5      6: 3+5
7: 1+6      8: 2+6      9: 3+6
*: 1+7      0: 2+7      #: 3+7

keypad pin 1: 1,5V
keypad pin 2: 3,3V
keypad pin 3: 5V

keypad pins 4,5,6,7: Arduino analog 0,1,2,3

Marloes van Son
*/

#include <MozziGuts.h>
#include <Oscil.h>           // oscillator template
#include <Smooth.h>
#include <tables/sin2048_int8.h> //wavetable for oscillator
#include <tables/square_no_alias_2048_int8.h> //wavetable for oscillator

// use #define for CONTROL_RATE, not a constant
#define CONTROL_RATE 64           // powers of 2

// addressing the wave-tables + audio rate
Oscil <SIN2048_NUM_CELLS, AUDIO_RATE> rowSin(SIN2048_DATA);
Oscil <SIN2048_NUM_CELLS, AUDIO_RATE> colSin(SIN2048_DATA);
Oscil <SIN2048_NUM_CELLS, AUDIO_RATE> opSin1(SIN2048_DATA);
Oscil <SIN2048_NUM_CELLS, AUDIO_RATE> opSin2(SIN2048_DATA);
Oscil <SIN2048_NUM_CELLS, AUDIO_RATE> pSin(SIN2048_DATA);
Oscil <SQUARE_NO_ALIAS_2048_NUM_CELLS, AUDIO_RATE> pSquare(SQUARE_NO_ALIAS_2048_DATA);
// square wave sound source

//variables for the rows of the keypad
const char keypad123 = 0;
const char keypad456 = 1;
const char keypad789 = 2;
const char keypad000 = 3;

// initialise frequencies for the keypad
int rowFreq1 = 0;
int rowFreq2 = 0;
int rowFreq3 = 0;

```

```

int rowFreq4 = 0;
int colFreq1 = 0;
int colFreq2 = 0;
int colFreq3 = 0;
int opFreq1 = 0;
int opFreq2 = 0;
int opFreq3 = 0;
int opFreq4 = 0;
int opFreq5 = 0;
int opFreq6 = 0;
int pFreq1 = 0;
int pFreq2 = 0;
int pFreq3 = 0;
int pFreq4 = 0;
int pFreq5 = 0;
int pFreq6 = 0;
int pFreq7 = 0;
int pFreq8 = 0;
int pFreq9 = 0;
int pFreq10 = 0;
int pFreq11 = 0;
int pFreq12 = 0;
int sFreq1 = 0;
int sFreq2 = 0;
int sFreq3 = 0;
int sFreq4 = 0;
int sFreq5 = 0;
int sFreq6 = 0;
int sFreq7 = 0;
int sFreq8 = 0;
int sFreq9 = 0;
int sFreq10 = 0;
int sFreq11 = 0;
int sFreq12 = 0;

const char led = 13;

// thresholds for the keypad
int thresh = 100;
int thresh147 = 300;
int thresh258 = 1000;

// initialising the switches
int switch_1 = 8;
int switch_2 = 10;

boolean switch11 = false;
boolean switch10 = false;
boolean switch01 = false;
boolean switch00 = false;

```

```

boolean output = false;

int asig = 0;
int clipped = 0;

//-----

void setup() {
  Serial.begin(115200);
  startMozzi(CONTROL_RATE);    // set a control rate of 64 (powers of 2)

  // switch the led on
  pinMode(led, OUTPUT);
  digitalWrite(led, HIGH);

  pinMode(switch_1, INPUT);
  pinMode(switch_2, INPUT);
}

//-----

void updateControl(){
  //read the analog pins: the keypad buttons
  int pressed123 = mozziAnalogRead(keypad123);
  int pressed456 = mozziAnalogRead(keypad456);
  int pressed789 = mozziAnalogRead(keypad789);
  int pressed000 = mozziAnalogRead(keypad000);

  // read the switch pins
  int switch_state_1 = digitalRead(switch_1);
  int switch_state_2 = digitalRead(switch_2);

  if(switch_state_1 == HIGH && switch_state_2 == HIGH) {
    // customer dialed frequencies
    switch11 = true;
    switch10 = false;
    switch01 = false;
    switch00 = false;
    rowFreq1 = 697;
    rowFreq2 = 770;
    rowFreq3 = 852;
    rowFreq4 = 941;
    colFreq1 = 1209;
    colFreq2 = 1336;
    colFreq3 = 1477;
  }

  if(switch_state_1 == LOW && switch_state_2 == LOW) {
    // operator frequencies
    switch11 = false;
  }
}

```

```

switch10 = false;
switch01 = false;
switch00 = true;
opFreq1 = 700;
opFreq2 = 900;
opFreq3 = 1100;
opFreq4 = 1300;
opFreq5 = 1500;
opFreq6 = 1700;
}

if(switch_state_1 == HIGH && switch_state_2 == LOW) {
    // piano scale sine wave
    switch11 = false;
    switch10 = true;
    switch01 = false;
    switch00 = false;
    pFreq1 = 261;
    pFreq2 = 293;
    pFreq3 = 329;
    pFreq4 = 349;
    pFreq5 = 392;
    pFreq6 = 440;
    pFreq7 = 493;
    pFreq8 = 523;
    pFreq9 = 587;
    pFreq10 = 659;
    pFreq11 = 698;
    pFreq12 = 783;
}

if(switch_state_1 == LOW && switch_state_2 == HIGH) {
    // piano scale square wave
    switch11 = false;
    switch10 = false;
    switch01 = true;
    switch00 = false;
    sFreq1 = 261;
    sFreq2 = 293;
    sFreq3 = 329;
    sFreq4 = 349;
    sFreq5 = 392;
    sFreq6 = 440;
    sFreq7 = 493;
    sFreq8 = 523;
    sFreq9 = 587;
    sFreq10 = 659;
    sFreq11 = 698;
    sFreq12 = 783;
}

```

```

//row 1 - number 123
if(pressed123 > thresh) {
    rowSin.setFreq(rowFreq1);                // set the frequency
    if(pressed123 > thresh && pressed123 < thresh147) {
        //number = 1;
        colSin.setFreq(colFreq1);            // set the frequency
        opSin1.setFreq(opFreq1);
        opSin2.setFreq(opFreq2);
        pSin.setFreq(pFreq1);
        pSquare.setFreq(sFreq1);
    }
    if(pressed123 > thresh147 && pressed123 < thresh258) {
        //number = 2;
        colSin.setFreq(colFreq2);            // set the frequency
        opSin1.setFreq(opFreq1);
        opSin2.setFreq(opFreq3);
        pSin.setFreq(pFreq2);
        pSquare.setFreq(sFreq2);
    }
    if(pressed123 > thresh258) {
        //number = 3;
        colSin.setFreq(colFreq3);            // set the frequency
        opSin1.setFreq(opFreq2);
        opSin2.setFreq(opFreq3);
        pSin.setFreq(pFreq3);
        pSquare.setFreq(sFreq3);
    }
    output = true;
    Serial.println(pressed123);
}

//row 2 - number 456
if(pressed456 > thresh) {
    rowSin.setFreq(rowFreq2);                // set the frequency
    opSin2.setFreq(opFreq4);
    if(pressed456 > thresh && pressed456 < thresh147) {
        //number = 4;
        colSin.setFreq(colFreq1);            // set the frequency
        opSin1.setFreq(opFreq1);
        pSin.setFreq(pFreq4);
        pSquare.setFreq(sFreq4);
    }
    if(pressed456 > thresh147 && pressed456 < thresh258) {
        //number = 5;
        colSin.setFreq(colFreq2);            // set the frequency
        opSin1.setFreq(opFreq2);
        pSin.setFreq(pFreq5);
        pSquare.setFreq(sFreq5);
    }
    if(pressed456 > thresh258) {

```

```

        //number = 6;
        colSin.setFreq(colFreq3);                // set the frequency
        opSin1.setFreq(opFreq3);
        pSin.setFreq(pFreq6);
        pSquare.setFreq(sFreq6);
    }
    output = true;
    Serial.println(pressed456);
}

//row 3 - number 789
if(pressed789 > thresh) {
    rowSin.setFreq(rowFreq3);                // set the frequency
    opSin2.setFreq(opFreq5);
    if(pressed789 > thresh && pressed789 < thresh147) {
        //number = 7;
        colSin.setFreq(colFreq1);                // set the frequency
        opSin1.setFreq(opFreq1);
        pSin.setFreq(pFreq7);
        pSquare.setFreq(sFreq7);
    }
    if(pressed789 > thresh147 && pressed789 < thresh258) {
        //number = 8;
        colSin.setFreq(colFreq2);                // set the frequency
        opSin1.setFreq(opFreq2);
        pSin.setFreq(pFreq8);
        pSquare.setFreq(sFreq8);
    }
    if(pressed789 > thresh258) {
        //number = 9;
        colSin.setFreq(colFreq3);                // set the frequency
        opSin1.setFreq(opFreq3);
        pSin.setFreq(pFreq9);
        pSquare.setFreq(sFreq9);
    }
    output = true;
    Serial.println(pressed789);
}

//row 4 - number *0#
if(pressed000 > thresh) {
    rowSin.setFreq(rowFreq4);                // set the frequency
    if(pressed000 > thresh && pressed000 < thresh147) {
        //number = *;
        colSin.setFreq(colFreq1);                // set the frequency
        opSin1.setFreq(opFreq1);
        opSin2.setFreq(opFreq6);
        pSin.setFreq(pFreq10);
        pSquare.setFreq(sFreq10);
    }
}

```



```

    if(pressed000 > thresh147 && pressed000 < thresh258) {
        //number = 0;
        colSin.setFreq(colFreq2);                // set the frequency
        opSin1.setFreq(opFreq4);
        opSin2.setFreq(opFreq5);
        pSin.setFreq(pFreq11);
        pSquare.setFreq(sFreq11);
    }
    if(pressed000 > thresh258) {
        //number = #;
        colSin.setFreq(colFreq3);                // set the frequency
        opSin1.setFreq(opFreq2);
        opSin2.setFreq(opFreq6);
        pSin.setFreq(pFreq12);
        pSquare.setFreq(sFreq12);
    }
    output = true;
    Serial.println(pressed000);
}

// deactivate the output and set all signals to 0
if(pressed123 < thresh && pressed456 < thresh && pressed789 < thresh && pressed000 < thresh) {
    output = false;
    rowSin.setFreq(0);                          // set the frequency
    colSin.setFreq(0);
    opSin1.setFreq(0);
    opSin2.setFreq(0);
    pSin.setFreq(0);
    pSquare.setFreq(0);
}
}

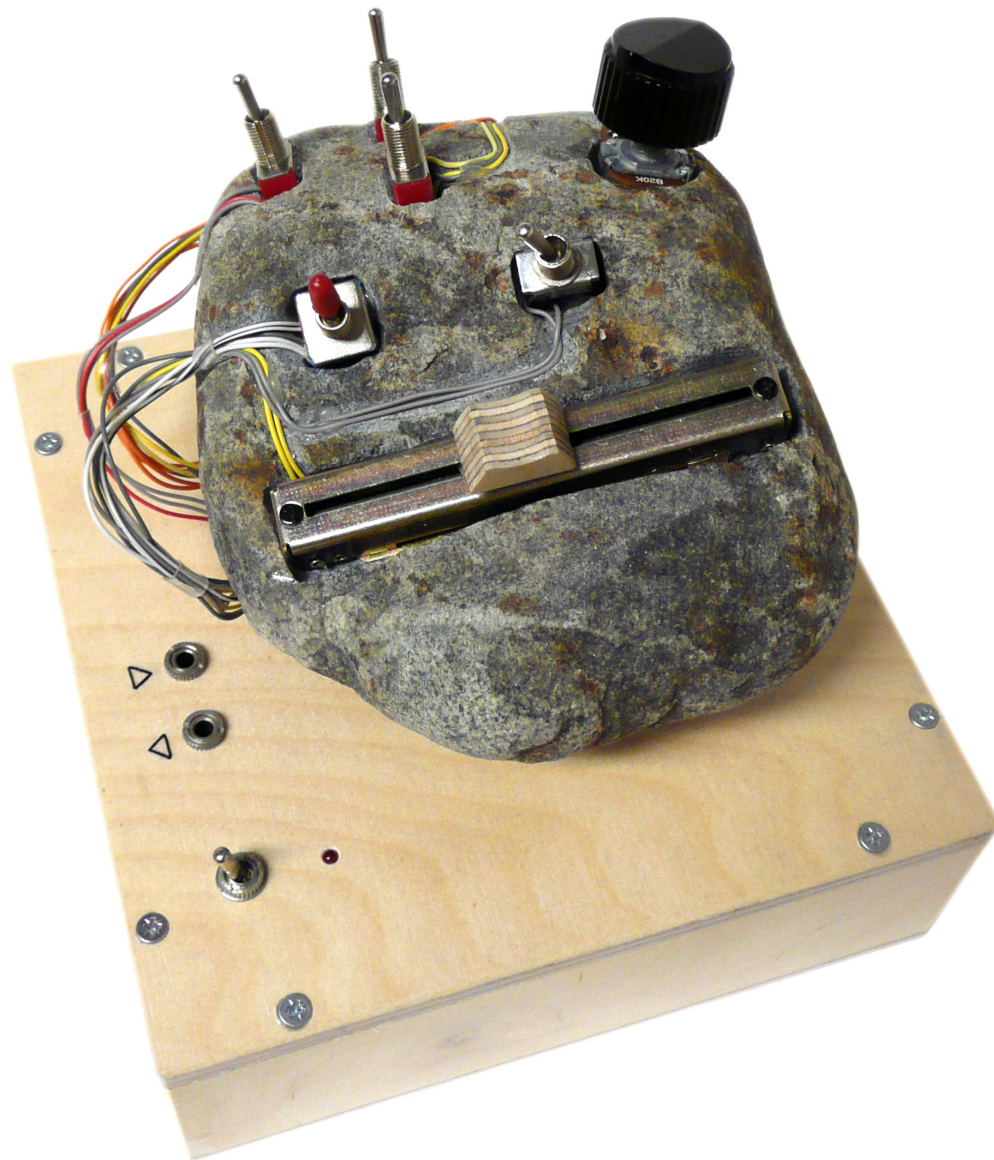
//-----

int updateAudio() {
    // only play sound when output is active
    if(output == true) {
        // add the soundwaves
        if(switch11 == true) {
            asig = rowSin.next() + colSin.next();
        }
        if(switch00 == true) {
            asig = opSin1.next() + opSin2.next();
        }
        if(switch10 == true) {
            asig = pSin.next();
        }
        if(switch01 == true) {
            asig = pSquare.next();
        }
    }
}

```


1.5 Rick

- image
- description
- schematics
- how the electronics of Rick work
- drawings and sketches
- user-manual



1.5 Rick

Rick is a rock-device with more than just a visual identity, it also possesses the ability to transform sound. When a sound-source and a speaker are connected to its in- and output, the signal passes through two integrated circuits, the 4049 and 4093. By switching between different capacitor values and changing the resistance with the potentiometer and fader, the output signal can be influenced. The included presets range from pulsating to timbral changes. The electronics are inspired by an original schematic from Nicolas Collins.

How the electronics of Rick work:

The input signal is sent to the first integrated circuit, the 4049. Here the signal is transformed into a distorted square-wave output. This signal is then connected to the control input of the NAND gate oscillator. For the NAND gate oscillator different capacitor values can be accessed with the switches, by changing these values differences in timbre and pulsating / chopping speed can be heard.

.....
INPUT

4049 CMOS Hex Inverting Buffer and Converter

This integrated circuit contains 6 inverters. These inverters are mainly used in digital electronics; they convert the input signal to its opposite. If the input is low, the output will become high. When one feeds an analog signal into the hex inverter, it will be converted to a rough distorted square wave signal.

4093 Quad 2-Input NAND Schmitt Trigger

This integrated circuit works as a logic gate, it compares the signal on two input pins, if both of the signals are HIGH, the output will also be HIGH, if only one signal is HIGH, the output will also be HIGH, and if both signals are LOW, the output signal will be LOW.

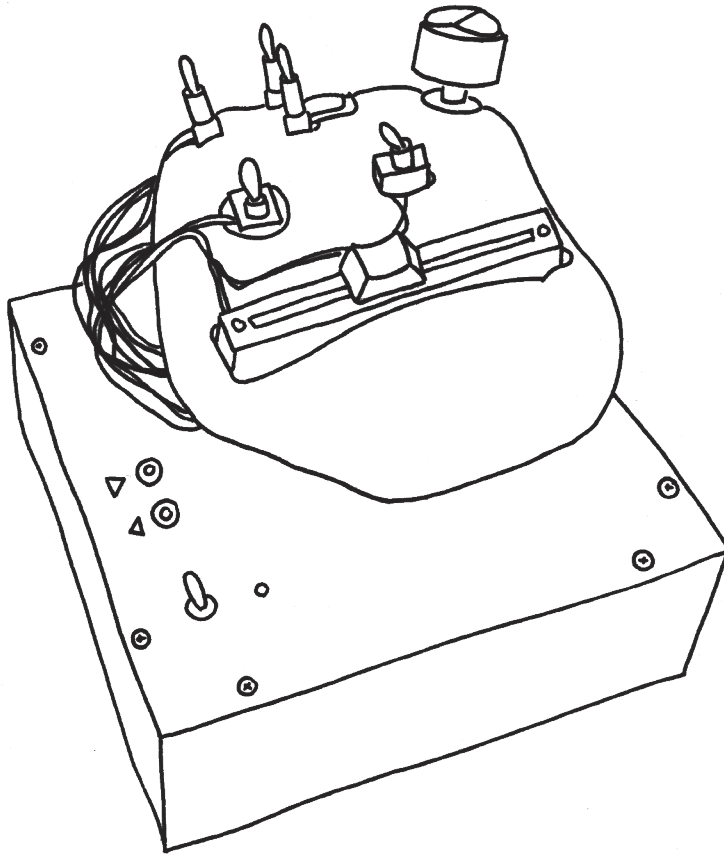
OUTPUT
.....

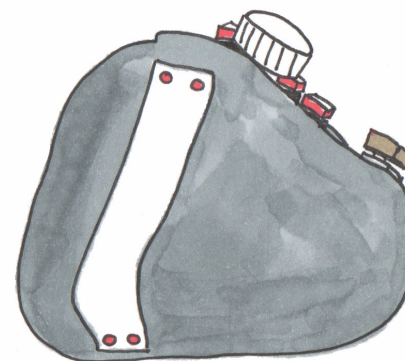
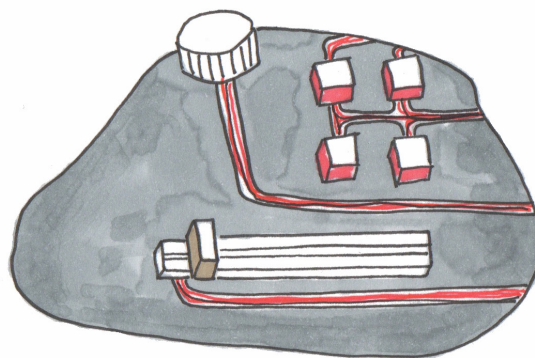
Sources:

<http://www.ti.com/lit/ds/symlink/cd4093bc.pdf>

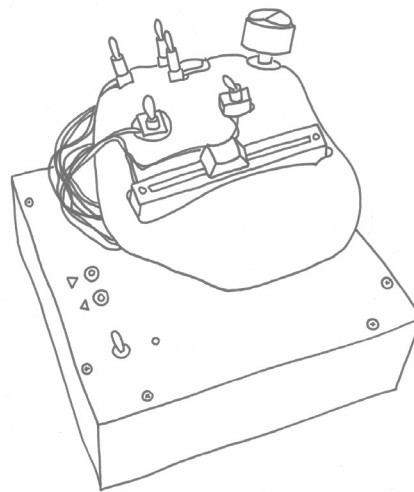
<http://www.ti.com/lit/ds/schs046j/schs046j.pdf>

Collins, N. (2009). *Handmade Electronic Music*. Second Edition. New York: Routledge.





USER MANUAL



.....

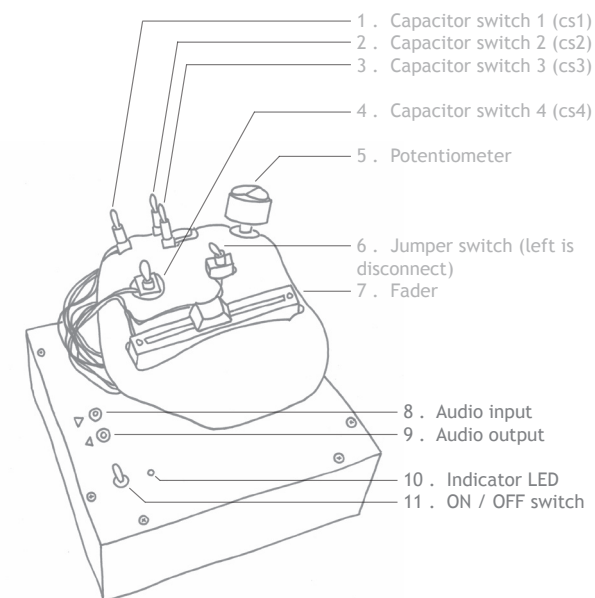
Rick: Rick is a rock-device with more than just a visual identity, it also possesses the ability to transform sound. Connect a sound-source and a speaker to its in- and output. Switch between different capacitor values and change the resistance with the potentiometer and fader. The included presets range from pulsating to timbral changes. (Electronics inspired by Nicolas Collins)

.....

INSTRUCTIONS

Connect a sound-source and a speaker to the audio output (1). Switch Rick on (2). Access different sound-presets with the switches (4, 5). Change the resistance with the potentiometer and fader. Disclaimer: Rick has its own will and can be rather unpredictable.

.....



cs1 switched up: cs2 activated

cs1 switched down: cs3 activated











cs2 switched up: 100uF capacitor
cs2 switched down: 10 uF capacitor

cs3 switched up: 1 uF capacitor
cs3 switched down: 0.1 uF capacitor

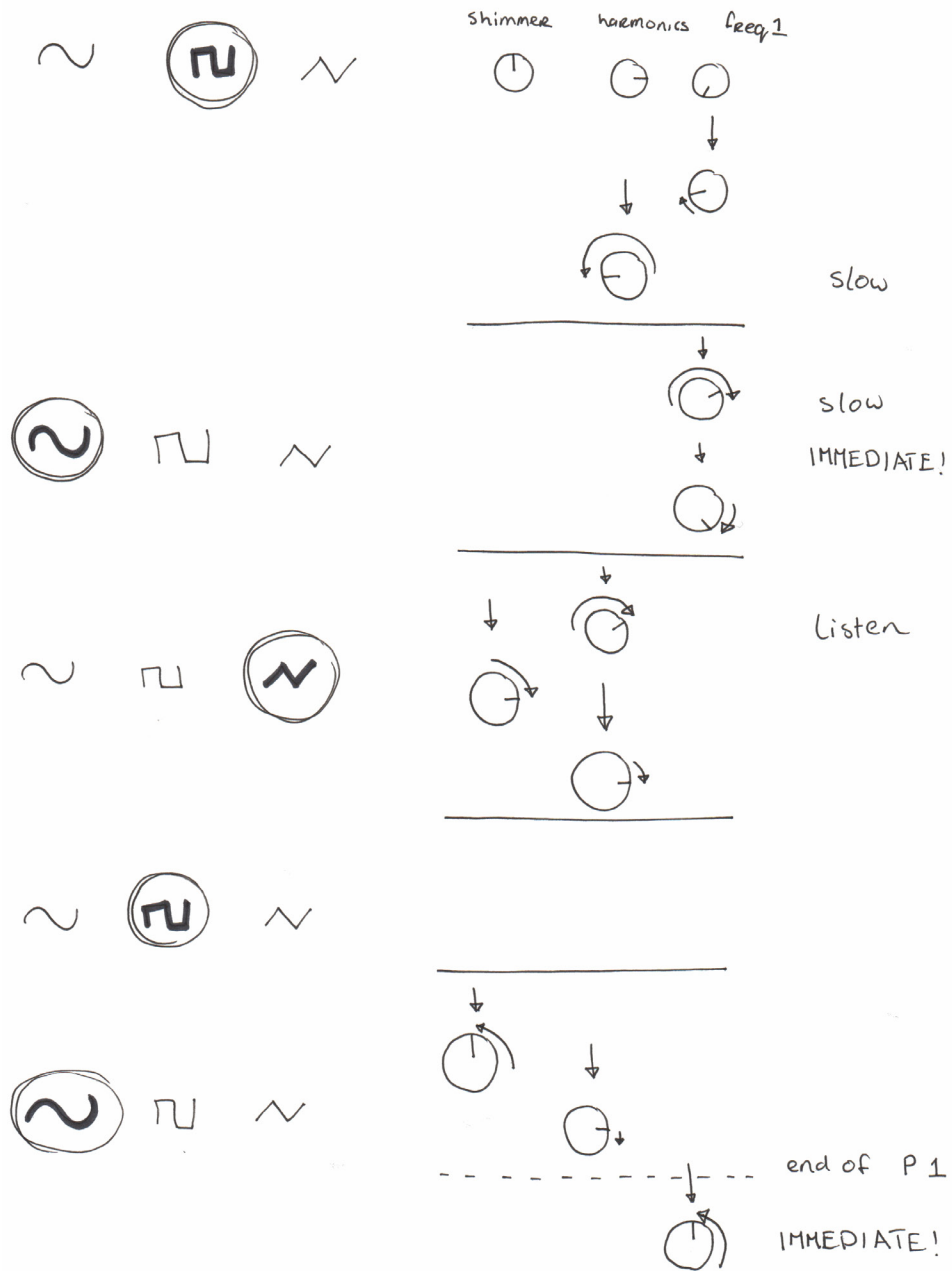
2. Scores

- Score for CardBox
- Score for Dash
- Cubed

Score for CardBox

	shimmer	harmonics	freq 1
□	 1/2	 3/4	 1/4
		↓ slowly  to 1/4	
~			↓ slowly  to 3/4 ↓ immediate  to max
≡		 to 10 past	
	↓  to 3/4	↓ Listen!  to ± 3/4	
□			
~	↓  to 1/2	adjust harmonics?	
		→ end tone: adjust harmonics?	

DASH composition - Marloes van Son ^{L1}



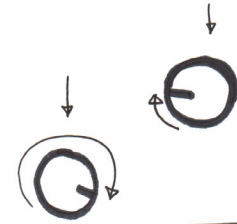


shimmer harmonics freq 1 2
medium

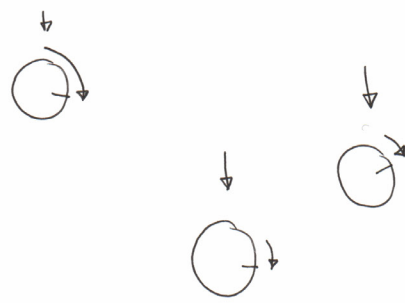


ON
▶ default

freq 1 freq 2 distortion volume



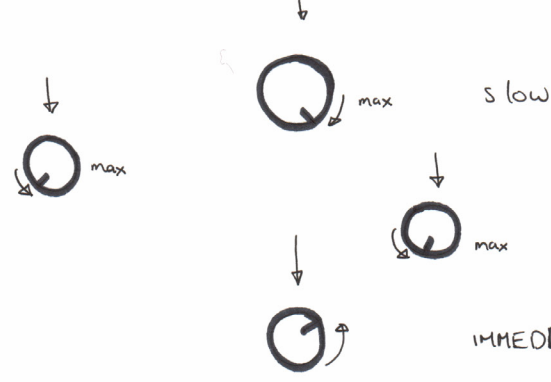
shimmer harmonics freq 1



adjust /
listen!



freq 1 freq 2 distortion volume



IMMEDIATE!





switch ON

FADE OUT

Card Box

freq 1 freq 2 distortion volume



(until slow + stop)

FADE OUT

Instrument # 8

FADE OUT

Reso

CUBED

100 BPM

①

~ ⊖ ⊖ Q ⊖ REC [A]

~ ⊖ REC [B]

~ ⊖ REC [C]

~ ⊖ REC [D]

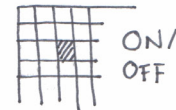
FADE OUT [A] [B] [C] [D]

ERASE Loops

RESET Volume

adjust ⊖ ⊖ Q

[3] U 198



REC [A]

adjust volume [A] → 6

~ ⊖ ⊖ Q 1x

~ ⊖ ⊖ Q 1x

~ ⊖ ⊖ Q 1x

FADE OUT [A]

~ (adjust) LAYER REC [B]

~

FADE OUT [B]

~

REC [C]

(2)

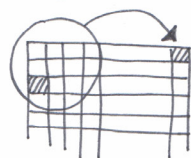
switch off ~

[1] 4 195

① ① ① ③

~ fade in ③ (slow beat)

adjust volume [C] → 4



RECORD
many
layers!

REC [D]

Switch off ~

FADE IN [B] → 4

[A] → 4

FADE IN [A] [B] [C] → 7

① ② ③ ④

FADE OUT [B]

OUT [C]

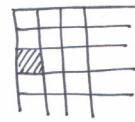
OUT [A]

OUT [D]

Switch on
+ fade in RESO

2 u 196

3



fade in



slowly!

adjust low / mid / high → min

END

3. Notes made during the exhibition at the Tekniikan Museo

3.1 Notes about visitors

3.2 Notes about out-of-order instances

3.3 Possible exhibition improvements

Appendix 3: Notes made during the exhibition at the Tekniikan Museo

3.1 Notes about visitors

Visitor count of the Out-of-Order exhibition at the Tekniikan Museo Helsinki:

During the week it was rather quiet, between 10 and 20 visitors per day.

On Saturday there were approximately 125 visitors and on Sunday around 80.

Main museum audience: mums with kids under 10, retired men, sometimes young dads with kids. All Finnish except for two students.

Some of the encounters that I described:

Tuesday 31.01.2017

Main interaction with the following visitors: museum staff and a group of retired, ex-engineers who volunteer at the museum.

The volunteers were generally supportive and showed enthusiasm towards my devices. Some were surprised that I had built them completely by myself, including electronics, soldering and woodwork.

One of the volunteers suggested adding an oscilloscope to also make the sounds visible in an additional way.

Wednesday 01.02.2017

I felt out of place, sitting at the table within my exhibition. Somehow people seemed scared to approach my corner and I felt a huge language barrier. RESO is most popular, because its controls are simple even though its sound output is not very rich.

Thursday 02.02.2017

a blond lady in a striped shirt with a girl and a little boy were very interested in the devices. They asked if I also made music with them.

A guy in a grey sweater looked at some of the devices and sat down! He tried the potentiometers, but nothing happened. Then he took the user-manual and started to experiment with RESO on very low volume. Then he seemed to feel awkward and left.

I am definitely scaring people away. Is the solution to continuously play sounds to make people curious? I should lure people in more. Also, the name of my exhibition is 'Out-of-Order', maybe people think that they shouldn't look because the exhibits might not be properly functioning?

Friday 03.02.2017

Observing from a distance indeed works a lot better:

A couple -bold man and a short haired lady- tried my devices in a very focussed manner. They really took the time to both read the user-manuals and explore sounds.

A man with grey hair and design glasses is exploring: he really seems to be listening and trying to find some specific,

but undefined sounds. User-manual in one hand, changing settings with the other. This is what I am aiming for!

Saturday 04.02.2017

I am observing from a distance again and what I see makes me very happy! The exhibition setup really seems to work as I hoped when I am not physically present. The setting seems to invite people to play and explore. Most people try something first, then check the user-manual and really start playing around. Many visitors took pictures. People are handling my devices very carefully. Some visitors also checked the background info-book with a lot of attention.

Sunday 05.02.2017

The last day of my exhibition at the Tekniikan Museo. Thinking back: Yesterday's events confirmed that my setup and ideas work. People do get curious, start exploring the device and the manual, figure out some way to use it.

Does the audience gain some understanding of how and why things work the way they do? People do connect LAMP (See appendix 1.2) to dynamo's and I overheard one lady who started speculating about the sound, movement and light connection in RESO (See appendix 1.1). So up to a certain point people do seem to gain an understanding or start to speculate about how these (and other familiar) devices function. I also heard people discuss these speculations, some formed theories and corrected each-other while discussing them.

A lady came especially for my exhibition (long grey hair, fringe, took her hiking shoes off, she told me that her husband was waiting in the car outside, as they had been bird-watching in the morning, so she couldn't stay long). She watched and tried my devices and then came to talk to me. She thought LAMP was humorous, couldn't get Rick to work and liked the exhibition overall. She told me about her husband's brother who used to build synths, so my devices looked somewhat familiar to her. He had passed away, but she still had his old equipment in the basement. Since my exhibition reminded her of him, she said that she might bring his synths from the basement upstairs to remember him. She was also the second person to tell me that, because she didn't recognise my name as female, she initially thought that I would be a man.

There was a very intense group of people around 14:00h. At least four kids and a lady who moved Phynth (see appendix 1.4) to another table. I was a bit scared at some point that the kids would drop LAMP (appendix 1.2). I almost intervened, but all went well in the end.

There were at least two (groups of) people specifically asking for my exhibition at the front desk on Sunday.

3.2 Notes about out-of-order instances

(see appendix 1 for more information on the described devices)

Tuesday 31.03.2017

Rick + Phynth becoming (temporarily) out-of-order during the opening:

M was playing Rick (appendix 1.5), L was playing Phynth (appendix 1.4). At some point they had some really nice sounds going on: heavily pulsating, slightly distorted tones. Then somehow we found out that something was wrong, either the sound didn't change anymore, or Phynth did no longer react to buttons being pushed.

I noticed that the light from Phynth was blinking rapidly. I disconnected Phynth from Rick and tried them separately:

Phynth still made no sound, only pulsating light. That worried me, but I figured that Rick might have generated some sort of backwards pulse that messed with the Arduino-memory. That was not exactly the case, as Phynth worked only for a short while after re-uploading the program, but then started blinking again, even without connecting Rick. Then the battery of Phynth was empty; Phynth did not switch on anymore. I replaced the battery. While testing afterwards I noticed a strange 'blinking' in the light again, but this time it was different, less regular. I realised that the metal casing of the 9V battery was touching the poles from the on/off-switch, effectively creating a short circuit, and draining the battery: I put a layer of tape around the battery and the problem has not reoccurred since. Conclusion: Phynth drained its own battery, when the battery from Rick became more charged than Phynth's battery, current/voltage started flowing backwards, messing with the Arduino programming memory.

Thursday 02.02.2017

Realisation: Rick is a device that does something, but not exactly what I want (like the sea simulators).

Saturday 04.02.2017

Just a little Phynth problem again... Battery just empty?

Sunday 05.02.2017

RESO (appendix 1.1) started to behave strangely, I think the battery is empty.

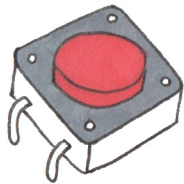
Rick does not work as an effect-unit at the moment, I didn't dare anymore after the opening event. Also Phynth is doing some unexpected weird things: Either the battery wasn't completely full, or it gets empty very fast. Faster than the other devices at least, which is strange, because it's only powering an Arduino, and LED and some switches. When the battery gets a bit low, the '2570-column' starts to sound the same as the '369#-column'. Is this a threshold problem? But how can the threshold change so much? Is it because of the shitty cheap Arduino? On Saturday Phynth also started blinking again at some point during the day, it sounded great, but why does that happen? And how? Rick works very well as a stand-alone synth though!

2.3 Possible exhibition improvements

I would want to present the schematics closer to the actual device it corresponds with.

LAMP (appendix 1.2) seemed out of place, since it is not a sound-device. I might have to leave it out of upcoming exhibitions.

Working with batteries is really annoying and unreliable. I would like to use phantom power from the mixer instead to provide the devices with power.



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